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Intensive stuttering therapy based on neuroplasticity and motor learning principles: treatment efficacy for adults who stutter

Daniel Shubert
Western Washington University

INTENSIVE STUTTERING THERAPY BASED ON NEUROPLASTICITY AND MOTOR LEARNING PRINCIPLES: TREATMENT EFFICACY FOR ADULTS WHO STUTTER

By

Daniel Shubert

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Kathleen L. Kitto, Dean of the Graduate School

ADVISORY COMMITTEE

Chair, Dr. Barbara Mathers-Schmidt

Dr. Michael Fraas

Dr. Kimberly Peters

Yarrow Pospisil

MASTER'S THESIS

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Daniel Shubert
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In Partial Fulfillment
Of the Requirement for the Degree
Master of Arts

by
Daniel Shubert
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Abstract

This study examined the efficacy of an intensive stuttering therapy program that was highly structured and based on neuroplasticity and the principles of motor learning. Treatment sessions were conducted in person and through Skype 4 days a week for a total of 8 weeks. Speech samples were collected throughout the study during Skype testing sessions and through self-recordings by the participants. These samples were analyzed for percent stuttered syllables and naturalness rating. Outcome measures also included a series of self-ratings by the participants and the completion of selected sections of the Overall Assessment of the Speaker's Experience of Stuttering (OASES). Results indicated that the participants' levels of disfluency and self-ratings improved throughout the course of the study. Individual differences in response to treatment are discussed.

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As proposed by Smith and Kelly (1997), stuttering is a multifactorial, non-linear, and dynamic disorder whose features vary widely among individuals. The multifactorial aspect of stuttering includes the influences of family history, social context, linguistic processes, emotional/autonomic factors, and speech motor organization. Stuttering is a non-linear and dynamic disorder because it involves processes that are constantly changing and cannot be categorized into distinct events. A small change in one aspect of the system can lead to dramatic changes in the overall behavior of the system. Smith and Kelly suggested that individuals who stutter (IWS) have a speech motor system that is vulnerable to disruption when the demands of speech exceed the capacity of the system. Their model is similar to other multifactorial models including the demands and capacity model proposed by Starkweather (1987). These underlying components of stuttering manifest to listeners as disfluency which is commonly categorized into repetitions, prolongations, and blocks.

Research investigating the neurological basis of stuttering has revealed a plethora of information about differences in both brain physiology and motor timing in IWS. Theories of brain dysfunction propose that stuttering may be due to atypical development of brain structures, possibly related to heritable genes. In a review of the recent advances in determining the neural basis of stuttering, Chang (2011) discussed the differences research clinicians have found between non-stuttering individuals (NSI) and IWS through the advancing technology of brain imaging. Studies have found that IWS may have aberrant connections in the left hemisphere which involves a major white-matter tract. A decrease in white matter-integrity has been found in the left superior longitudinal fasciculus in both adults and children who stutter (Chang, Erickson, Ambrose, Hasegawa-Johnson, & Ludlow, 2008; Cykowski, Fox, Ingham, Ingham, & Robin, 2010; Sommer, Koch, Paulus, Weiller, & Buchel, 2002; Watkins, Smith, Davis, &

Howell, 2008). Research clinicians have also found underactivity in the auditory cortex, overactivity in motor regions, and heightened right hemisphere activity during speech tasks (Braun et al., 1997; Chang, Kenney, Loucks, & Ludlow, 2009; Fox et al., 1996).

A study conducted by Kell et al. (2009) investigated the neurological differences in recovered stutterers (RS) and persistent stutterers (PS) in order to locate the areas of the brain associated with compensation for stuttering and recovery for stuttering. Brain imaging during speaking tasks was conducted for controls, RS, and PS before intervention, and PS after intervention. The results showed that PS retained permanent grey and white matter differences while RS only showed a difference in grey matter. After therapy, a majority of the excess neural activity in the right dorsal frontal and parietal regions in PS was eliminated. However, both PS and RS showed reduced activity in the orbito-frontal cortex. This research shows that therapy can have a direct impact on reducing the excess neural activity found in PS and demonstrates the importance of providing intervention that helps to rewire aberrant connections in the left hemisphere.

In relation to neurological differences that have been found in IWS, deficiencies in the motor function of IWS have been suspected and systematically researched since the first third of the 20th century. Yairi and Seery (2011) outlined three major systems involved in the regulation of movement: sensations and perceptions, decisions and instructions, and movements and actions. A motor deficit that may contribute to the development and maintenance of stuttering may occur in any of these three systems and may involve processes of respiration, phonation, and/or articulation. Research conducted by Johnston et al. (1993) showed that IWS tended to display significantly higher or lower lung volumes during fluent speech, and poor timing of breath patterns was observed by Williams and Brutten (1994). Counture, McCall, and Brewer

(1977) reported that stuttered events involved simultaneous contractions of antagonistic vocal fold adductor and abductor muscles. Shapiro (1980) found that IWS had higher levels of EMG activity, or tension, during speech and Zimmerman (1980) reported that fluent speech in IWS is on average slower than NSI. All of these differences add evidence to the theory that there is a motor deficit in the muscles involved in speech for IWS, but recent research has found that motor differences also exist in completely unrelated muscles.

A research investigation conducted by Max, Caruso, and Gracco (2003) found that IWS displayed differences in the motor timing of speech movements, orofacial nonspeech movements, and finger movement tasks. The data suggested that IWS may have a generalized rather than speech specific neuromotor difference. The authors of the study wondered if these neuromotor differences were part of the cause of stuttering or a result of a lifetime of persistent stuttering. A study conducted by Olander, Smith, and Zelanzik (2010) investigated whether, near the age of onset, young children who stutter display a basic motor timing or coordination deficit. The research clinicians found a significant difference in the interclap interval for 60% of the CWS, but the rest of the CWS performed within the normal range. The authors concluded that their results, which are consistent with those of Max, Caruso, and Gracco (2003), support the notion that differences in timing, coordination, and synchronization of articulators are influenced by a general motor timing deficit. They hypothesized that perhaps the subgroup of CWS that did not show a motor timing difference may be those children who will spontaneously recover from stuttering. This research suggests that therapy for IWS should focus on targeting the motor aspects of speech and adds support to the efficacy of using motor-based therapy approaches.

Further support for motor based treatment programs has come from the recent research investigating neuroplasticity. Ludlow et al., (2008) defined neuroplasticity as "... the ability of

the central nervous system to change and adapt in response to environmental cues, experience, behavior, injury or disease" (p. S241) Maas et al. (2008) investigated the relationship between nine principles of motor learning that have been identified through research investigating nonspeech motor tasks, and their application to treatment for motor speech disorders. These nine principles included: practice amount, practice distribution, practice variability, practice schedule, attentional focus, target complexity, feedback type, feedback frequency, and feedback timing. The following is a review of each of these motor principles and their relationship to motor speech disorders as outlined by Maas et al..

Practice amount: large vs. small. Research for nonspeech tasks revealed that a large number of practice trials was beneficial for learning motor skills. No empirical evidence currently exists in relation to speech motor learning. Treatment programs such as LSVT (Fox et al., 2006) use large practice amounts but research has not been conducted to determine whether small practice amounts would be just as efficacious. Information presented by Yorkston, Beukelman, Strand, and Hake (2010) stated that speech motor learning requires experience and must be practiced over and over to build motor skills. Repeated opportunities for correct productions are necessary.

Practice distribution: massed vs. distributed. Research for nonspeech tasks indicates that distributed practice is more efficacious for both short-term performance and long-term learning but further research is needed in the speech domain (Maas et al., 2008). Yorkston, Beukelman, Strand, and Hake (2010) stated that within motor speech tasks, massed practice is more beneficial for accuracy of movements within the training session but distributed practice is better for retention and generalization of movements.

Practice variability: constant vs. variable. Research for nonspeech tasks indicate that

variable practice is more beneficial for the learning of absolute aspects of movement, while constant practice early on in treatment is beneficial for the learning of relative aspects of movement. Maas et al. (2008) stated that some evidence gathered from unimpaired speakers may suggest similar results for speech motor learning but there continues to be a need for more research. Yorkston, Beukelman, Strand, and Hake (2010) suggested that differing the context, conditions, and challenge level of motor speech tasks benefits the improvement of motor speech.

Practice schedule: blocked vs. random. Research for nonspeech tasks revealed that random practice is superior for the retention and transfer of motor tasks. However, random practice was found to be more beneficial for absolute aspects of movement and blocked practice was superior for early learning of relative aspects of movement, similar to findings for practice variability. Maas et al. (2008) reported that evidence in the speech domain suggests that random practice may be superior for both intact and impaired speech motor systems.

Attentional focus: internal vs. external. Research for nonspeech tasks found that an external task-relative focus was superior because it promotes movement and automaticity and produces greater retention. However, this aspect has not yet been explored for speech (Maas et al., 2008).

Target complexity: simple vs complex. Research for nonspeech tasks indicates that both simple and complex targets have advantages depending on the task. Simple targets were found to be superior for sequential movements with easily separable components while complex targets were superior for practice of movements that were governed by a single generalized motor program (GMP). Maas et al. (2008) stated that preliminary evidence suggests that using complex targets in treatment may be the most beneficial; further research is needed.

Feedback type: knowledge of performance (KP) vs. knowledge of results (KR). Research

for nonspeech tasks has revealed that KR and KP are equally effective in most cases; however, KP is more useful when the task is novel and unclear but may be detrimental when provided during performance. Maas et al. (2008) indicated that there is not currently enough research to determine which is superior for speech tasks, but Yorkston, Beukelman, Strand, and Hake (2010) stated that KR is superior for overall learning in motor speech tasks.

Feedback frequency: high vs low. Research for nonspeech tasks shows that reduced frequency feedback is beneficial for motor learning but frequent feedback appears to also enhance parameter learning. Maas et al. (2008) stated that preliminary evidence suggests that a low frequency feedback may be the most beneficial option for speech motor learning.

Feedback timing: immediate vs delayed. Research for nonspeech tasks shows that delayed feedback is superior because it facilitates internal movement evaluation. Evidence for speech motor tasks is limited; however, it suggests that delayed feedback may also be beneficial for speech tasks (Maas et al., 2008).

These principles of motor learning and the knowledge we have gained about neuroplasticity have recently been applied to aspects of speech-language pathology treatment. The Lee Silverman Voice Treatment (LSVT) is a four week intensive therapy program for improving vocal function, primarily for individuals with Parkinson's disease (Fox et al., 2006). Their treatment program includes planned activities that are completed daily during the sessions, carryover assignments that extend this practice into real life situations, and home practice activities that are completed daily. The authors stated that the success of LSVT may be related to the "... intensive mode of delivery that is consistent with neural plasticity promoting principles" (Fox et al., 2006, p. 284). They also discussed the effect of a single treatment target (loudness/amplitude) and the mode of delivery (intensity/neural plasticity) on positive treatment

outcomes. The key principles that were incorporated into their therapy approach included: intensity (frequency of treatment and repetitions within sessions), complexity (training from simple to more complex), use it or lose it (related to Parkinson's disease being a degenerative disease), use and improve it (active attention to sensory feedback is essential for neural plastic change), and timing matters (also related to Parkinson's being a degenerative disease). Many studies have been conducted to demonstrate the efficacy of LSVT (PD; Pinto et al., 2004; Ramig, Countryman, Thompson,&Horii, 1995; Ramig, Sapir, Countryman, et al., 2001; Ramig, Sapir, Fox, & Countryman, 2001; Schulz, 2002; Yorkston, Spencer, & Duffy, 2003).

Yairi and Seery (2011) divided their recommendations for treatment of adults who stutter into two major categories: treatment that focuses on emotional reactions and treatment that focuses on stuttering and fluency. Yairi and Seery stated that there are emotional components to the stuttering of many adults who stutter and that this emotional component may be so strong that it overshadows the disfluent speech. Treatment targeting the emotional reactions to stuttering focus primarily on physical relaxation techniques, desensitization, assertiveness training, and anxiety management. Yairi and Seery split treatment that focuses on stuttering and fluency into two major categories: identification and modification. Identification focuses on the client's awareness of disfluency so that these disfluencies can later be modified in a way that reduces the overall level of disfluency within the client's speech. These modifications to speech are often separated into fluency shaping, in which the person alters the way they speak throughout a conversation, and stuttering modification, in which the person alters their speech only when disfluency or the expectation of disfluency is experienced. A combination of both strategies is often incorporated into stuttering therapy programs. This symptom oriented approach helps the person who stutters develop a sense of power over speech. The fact that they

know they can overcome previous struggle behavior with planned and controlled speech movements is in itself a form of psychological therapy (Yairi & Seery, 2011). According to the American Speech-Language-Hearing Association (ASHA) Guidelines for Practice in Stuttering Treatment (ASHA, 1995), there is variability in the timing and duration of treatment sessions. There are some residential programs that treat clients for six or more hours a day for a number of weeks; traditionally, stuttering therapy has been conducted by private clinicians one, two, or three times a week for the standard treatment time of 45 minutes to an hour. Recent advances in technology are beginning to change the way in which treatment is administered.

The use of telepractice as a means to serve patients who would otherwise be unable to attain speech-language pathology services may increase as technology advances. ASHA has been tracking the use of remote service delivery by speech-language pathologists since 1998 and in 2005, ASHA's Telepractice Working Group developed a position statement, technical report, and knowledge and skills statement to help guide speech-language pathologists in their use of telecommunication services. These statements were updated in 2013 with the incorporation of newer real-time audio and visual systems such as Skype (ASHA, 2013). The document states that, "Telepractice is an appropriate model of service delivery for audiologists and speech-language pathologists" (Roles and Responsibilities section, para. 1).

The use of telepractice has been studied in terms of its efficacy for stuttering therapy since before these superior telecommunication systems were widely used. For example, a study conducted by O'Brian, Packman, and Onslow (2008) investigated the efficacy of the Camperdown Program for Adults who stutter using telephone and email. Ten adults participated in the study and the results showed an 82% reduction in stuttering frequency immediately following therapy and a 74% reduction 6 months after treatment. The authors conclude that

preliminary data suggests that the Camperdown program has potential to be efficacious for clients who cannot access face to face treatment.

The current study incorporated what is known about neuroplasticity and the principles of motor learning into an intensive, structured stuttering therapy program utilizing telepractice. Treatment emphasized the speech motor learning aspects of fluency shaping. Similar to the way in which LSVT took what was known about motor learning and adapted it to best benefit those with Parkinson's disease, the current research adapted these principles to improve the effectiveness of the learning process involved in the use of fluency shaping skills. The principles of motor learning were addressed as follows:

Practice amount: large. Repeated trials of treatment tasks were completed at the participants' current complexity level within treatment sessions and outside of treatment sessions. Treatment was conducted four times a week for 50 minutes with home practice activities assigned every day.

Practice distribution: distributed. Treatment sessions included variations of treatment tasks throughout and periods of complete rest. Practice was also distributed between regularly scheduled treatment sessions and differing home practice completion times. Although treatment sessions were massed in terms of the intensive, four day a week treatment schedule, this was necessary to promote a large practice amount. The tasks within the sessions were distributed so that the treatment was more distributed than massed overall.

Practice variability: variable. Fluency shaping practice was conducted at the participants' current skill levels with tasks that included reading out loud, conversation in person with varying communication partners, conversation over the phone with varying communication partners, conversation over Skype with varying communication partners, and repeating functional phrases.

Practice schedule: random. Each treatment task was conducted for 3-5 minutes. Each day of treatment, each task was scheduled to occur at least twice in a completely random order including the periods of rest.

Attentional focus: internal initially with quick transition to external. During the learning phase of fluency shaping skills (e.g., light articulatory contacts, easy onset of phonation, reduced rate) internal focus was initially promoted. This focus was transitioned toward a more external focus as the use of fluency shaping skills required less conscious effort.

Target complexity: simple initially with quick transition to complex. In order to ensure successful practice, target complexity level began simple. Research participants were moved through complexity levels as readily as possible in order to attain the highest level of practice at the maximum complexity level.

Feedback type: KP initially with quick transition to KR. KP was utilized during the initial learning of fluency shaping skills in order to promote successful use of these skills. KR was then incorporated to promote increased focus on the overall feeling of "easy speech" rather than focusing on the specific components of fluency shaping.

Feedback frequency: high frequency initially with quick transition to low frequency. High frequency of feedback was utilized in the initial learning process for the use of fluency shaping skills. As the participants became more independent in their monitoring of fluency shaping skills, feedback became less frequent in order to promote independence.

Feedback timing: immediate initially with quick transition to delayed. Similar to feedback frequency, immediate feedback was utilized initially to ensure the correct use of fluency shaping skills. Feedback became delayed in order to promote increased independence.

The purpose of this study was to examine the efficacy of intensive stuttering therapy that

incorporates telepractice. The research clinician hypothesized that intensive therapy based on our current understanding of neuroplasticity and motor learning would result in improved fluency in two adults who stutter.

Method

Subjects

The study included two participants. The first participant (A) was a 44-year-old female who holds a master's degree and is an elementary school teacher. She reported the she began stuttering in the 4th-grade and she received services from a speech-language pathologist from 5th to 8th-grade. She received therapy in 1995 with a graduate student in a communication sciences and disorder program and continued therapy "off and on" since 1998 with a stuttering specialist from the same university. Participant A reported that her stuttering is often cyclical, in that it has gradually improved at times in her life and then has become more severe. She reported that the severity of her stuttering also varies throughout the day, with more difficulty during parent-teacher conferences, phone conversations, and meetings at work and less difficulty when speaking with family members at home. The factors that increase her stuttering were reported to be fear, stress, and scripted responses or greetings.

Before the initiation of treatment, the Stuttering Severity Instrument - 4th Edition (SSI-4) (Riley, 2009) and the OASES were administered. Participant A received a score of 31 on the SSI-4, which places her at the high end of the moderate range. The participant's speech was characterized primarily by an increased rate, repetitions, and blocks with jaw jerking, head jerking, facial grimacing, loss of eye contact, gasping, and tightness in the neck and jaw. However, it should be noted that the participant's score for the speaking task was 8 with 17% SS, while her score for the reading task was 2 with 1% SS. Due to the participants history of

stuttering therapy, she demonstrated the use of fluency shaping techniques to maintain fluency during the reading task. The low score for the reading task significantly lowered her overall score which led to a decreased severity rating. Based solely on the speaking task, the research clinician would subjectively rate the participant to stutter severely or very severely. The results of the OASES revealed an overall moderate/severe score, suggesting that the participant's stuttering is moderately/severely impacting her daily communication and quality of life and that she has moderate/severe emotional reactions to her stuttering.

The second participant (B) was a 21-year-old female working towards a bachelor's degree. She reported stuttering since early childhood and received services from a speech-language pathologist from age 3 to 10. Participant B reported that her stuttering is typically mild but can become moderate when she is uncomfortable or anxious. She reportedly does not avoid most situations, such as speaking on the phone, but does not like to raise her hand in class or give presentations because of her stuttering. Her most challenging speaking situations were reported to be talking with strangers, giving presentations, reading out loud, and speaking when she is tired or drowsy. Participant B reported that she "doesn't think about it too much" and her easiest speaking situations were with friends and other people she is comfortable with.

Before the initiation of treatment, the SSI-4 and the OASES were administered. Participant B received a score of 15 on the SSI-4, which places her in the very mild range. Her speech was characterized primarily by an increased rate, fast repetitions, and interjections of filler words when blocking. The participant reported that this speech sample was typical of her everyday speech, but her stuttering severity increases significantly in higher-challenge situations. The results of the OASES revealed an overall mild/moderate score. Section I: General Information was the most severely rated section with a moderate severity rating. However, the

quality of life section rated her severity as mild.

The Human Subjects Review Committee of WWU approved the study. The study was explained to both participants and written informed consent was obtained (see Appendix G).

Experimental Design

This study used an ABAB within-subject withdrawal design, which included four phases over a 14-week period: NT1 = baseline testing (1 week), T1 = first stuttering therapy treatment phase (4 weeks), NT2 = withdrawal phase (4 weeks), T2 = second stuttering therapy treatment phase (4 weeks).

Baseline data was gathered over four consecutive days and then once after the weekend on the Monday before the initiation of treatment. The baseline data consisted of measurements of percent stuttered syllables (%SS), naturalness, and self-rated anxiety, stuttering severity, and speech satisfaction. Measurements of self-reported avoidance and quality of life were administered once on the Monday prior to the initiation of treatment.

During the first stuttering therapy treatment phase (T1), measurements of %SS, naturalness, and self-rated anxiety, stuttering severity, and speech satisfaction were administered every Monday following each four-day week of treatment. Measurements of self-reported avoidance and quality of life were administered following two weeks of treatment and four weeks of treatment. The withdrawal phase (NT2) and second stuttering therapy treatment phase (T2) followed the same testing protocol as T1 except without treatment being administered for NT2.

Outcome Measures and Testing Procedures

Choosing appropriate treatment outcomes measure is a key aspect to demonstrating the clinical efficacy of a treatment protocol. Research conducted by Cream et al. (2010) investigated

the clinical efficacy of video self-modeling following speech restructuring treatment for stuttering. Their primary outcome measure was the %SS within participants' speech samples. A rating of speech naturalness along with the measurement of %SS is important because although a treatment may lower the overall disfluency, if the speech that is produced is highly unnatural it may be just as disruptive to communication as stuttering. They also included a series of secondary outcome measures that included: self-rated anxiety, self-rated stuttering severity, self-reported avoidance, self-rated satisfaction with fluency, and self-reported quality of life. Another study conducted by O'Brian, Onslow, Cream, and Packman (2003) used similar outcome measures and explained the importance of the self-reported measures as follow, "...the ultimate decision as to whether a particular participant has benefited from treatment should reside with that participant" (p. 938). These secondary outcome measures ensure that the improvement that may be seen in the analysis of speech samples is also leading to a more positive overall speaking experience for the participant.

%SS and speech naturalness.

Four speech samples were collected on each data collection day. These speech samples included a 3-minute monologue with one of two research assistants over Skype, a 5-minute conversation with the same research assistant over Skype, and two self-recordings of 5-minute high-challenge speaking situations completed by the research participants. For the monologue task, participants were asked to produce a 3-minute monologue about topics chosen by the research clinician (see Appendix A). For the 5-minute conversations with a research assistant, three "controversial" conversation topics were given to the research participants and they chose the topic they wanted to talk about (see Appendix B). During the conversation, the research assistant was instructed to remain neutral in her facial expression and speech patterns so that she

did not appear friendly. This was done to increase the challenge of the conversation. The research assistant was instructed to either interrupt, ask for clarification, or disagree with the research participant at least three times during the conversation (see Appendix A). The participants were given a small audio recording device on which to record the two 5-minute, high-challenge self-recordings that were completed for each data collection day. Due to the difficulty of maintaining a 5-minute conversation during some of those situations (e.g., ordering food at a restaurant) some of the recordings were not 5-minutes long. Participant B had particular difficulty recording herself in high-challenge situations due to the nature of those situations (e.g., giving two presentations a week was not feasible). However, Participant B reported significant difficulty reading out loud in front of people and chose that high-challenge situation as a treatment target. Although reading out loud in front of people is not considered a conversation, this task was approved by the research clinician as an appropriate self-recording speaking task due to the nature of Participant B's stuttering and her preferences for treatment targets.

Each of the previously listed four speech samples were analyzed for %SS and speech naturalness. The research assistants were given the following instructions adapted from Martin, Haroldson, and Triden (1984), "Your task is to rate the naturalness of each speech sample. If the speech sample sounds highly natural to you, circle the 9 on the scale. If the sample sounds highly unnatural, circle the 1 on the scale. If the sample sounds somewhere between highly natural and highly unnatural, circle the appropriate number on the scale. Do not hesitate to use the ends of the scale (1 or 9) when appropriate. 'Naturalness' will not be defined by you. Make your rating based on how natural or unnatural the speech sounds to you" (p. 54).

Self-rated anxiety and stuttering severity.

Following the completion of a 5-minute conversation with a research assistant over

Skype, the participants were asked to use a 1-100 scale to self-rate how anxious they felt during the previous conversation. They also were asked to use a 1-9 scale to self-rate their stuttering severity during the previous conversation. A visual scale was provided for the self-rated stuttering severity via the video feature of Skype. The instructions for administration of these treatment measures can be found in Appendix A.

Self-rated speech satisfaction.

Prior to the collection of a 3-minute monologue and 5-minute conversation with a research assistant over Skype, each participant was asked to rate her overall speech satisfaction on a 1-9 scale. The instructions that were given to the participants can be found in Appendix A. The participants were also shown a visual image of the scale via the video features of Skype.

Self-reported avoidance and quality of life.

Data pertaining to avoidance behaviors and quality of life were not collected during each testing session. These measures were recorded once during baseline testing, and twice during T1, NT2, and T2. These measures were gathered using specific sections of the OASES. These included section B under "Your Reactions to Stuttering," Section III: Communication in Daily Situations, which measures the effect stuttering has on the participant's willingness to participate in different situations, and Section IV: Quality of Life, which measures the effect stuttering has on an individual's quality of life. A full OASES was completed at the initiation of the study (NT1) and at the completion of treatment (T2).

Research Clinician

A majority of treatment sessions were conducted by the research clinician who is a graduate student in speech-language pathology. The research clinician had completed a graduate level course in fluency disorders and had completed supervised clinical experiences working in a

university clinic with individuals who stutter. The research clinician was supervised by the research advisor who is a stuttering specialist and certified clinician with extensive experience in the treatment of fluency disorders. Initial treatment sessions were conducted by the research advisor who subsequently supervised the research clinician to ensure treatment was being administered appropriately.

The two research assistants were graduate students in speech-language pathology. Instruction and training was given prior to the initiation of the study to ensure that research assistants were conducting Skype testing sessions appropriately and analyzing %SS and naturalness reliably.

Therapy Procedures

During treatment phases (T1 & T2), sessions were conducted four times a week for 50 minutes each. Three of the four sessions were conducted over Skype with video and audio, and one session was conducted in person at the Western Washington University Speech-Language-Hearing Clinic.

Due to the complex nature of stuttering and the wide variability amongst individuals who stutter, the program was individualized for each participant. Direct practice and instruction of stuttering modification techniques were not implemented in the treatment protocol; however, they were addressed when the research clinician believed those strategies would be beneficial for the research participants. Similarly, when emotional reactions needed to be addressed to provide optimal treatment to the participant, the research clinician discussed these emotions and provided counseling. Despite this necessary individualization, the primary focus of the treatment was the learning and use of fluency shaping skills to increase the research participants' overall level of fluency. A description of how each principle of motor learning identified by Maas et al. (2008)

was incorporated into treatment can be found in the introduction section of this paper. A treatment calendar was created for phase T1 of the study (Appendix H). This calendar was created before the initiation of the study to ensure that the research clinician was incorporating all of the principles of motor learning in therapy sessions. This initial calendar was then modified to fit the specific needs of each research participant in terms of complexity level of treatment tasks and the type of tasks that were included (e.g., conversations over the phone were removed for Participant B). Sample lesson plans and home practice sheets were modified to fit the specific needs of each research participant (Appendix C and Appendix D). The research clinician was careful to follow the treatment calendar as closely as possible with the needed modifications.

The fluency shaping techniques that the research clinician implemented were adapted from Yairi & Seery (2011). Treatment began with training in the use of a completely novel manner of speech that led to complete fluency. The speech was modified to implement the use of light articulatory contacts, easy onset of phonation, optimal breathing, reduced tension, and decreased rate. Initially, these strategies were exaggerated in order to maintain complete fluency. Participants practiced using this novel speaking style on a variety of tasks including reading aloud, producing a monologue or sentences, and practicing functional phrases.

As noted in the description of the previously mentioned principles of motor learning, treatment sessions and home practice were highly structured and specific. For examples of home practice sheets and lesson plans, see Appendix C and Appendix D. A hierarchy was used in terms of the treatment targets so that participants were constantly being challenged to use fluency shaping skills in higher challenging tasks. The research clinician was careful to move participants up the hierarchy as readily as possible, once participants demonstrated mastery at a particular level.

In order to follow what we know about neuroplasticity, the research clinician made sure that participants were only practicing at challenge levels where they would maintain controlled fluency. The hierarchy for each participant was individualized to fit the needs of each participant. For example, since Participant A had previous treatment experience using fluency shaping skills, the research clinician briefly had her practice with short phrases and sentences and quickly moved to simple monologues. From there, the participant moved from simple monologues, to complex monologues, to conversations with the clinician, and finally conversations with strangers. Participant B had not had previous fluency shaping therapy that she remembered and therefore more time was spent at the phrase level to ensure that the participant was utilizing the skills appropriately. She moved from phrases, to sentences, to simple monologues, to complex monologues, to conversations with the clinician, and then to giving mock presentations to a small group. Other treatment tasks included talking over the phone (Participant A), reading aloud, and practicing functional phrases. Again, further information about treatment targets and home practice can be found in Appendix C and Appendix D.

Another aspect of treatment was the development of functional phrases. This task was adapted from the LSVT program (Fox et al., 2006). At the first treatment session, each participant was asked to write down 10 phrases that they typically produce multiple times each day (e.g., “Hello, how are you?”). The participants were asked to use fluency shaping techniques to produce these phrases multiple times within each session and as home practice. The rationale for the extensive practice of these phrases was that the phrases would come to be cues in everyday life to switch into easy speech characterized by controlled fluency. When one of these phrases occurred in everyday life, the participant would automatically employ fluency shaping skills due to this extensive practice. This would then put them into what the research clinician

called the “easy mode” and lead to increased use of fluency shaping skills in the rest of the conversation.

Interjudge and Intrajudge Reliability

Two research assistants analyzed the speaking samples for %SS and naturalness. Prior to analyzing research samples, both assistants were given a protocol for determining the %SS and naturalness ratings. Training was conducted until both judges were analyzing speech samples from the initial interview within 2%SS of each other. Each research assistant scored half of the Skype samples and half of the self-recording samples in a random order. Following the completion of the analysis by both research assistants, the research clinician randomly scored 20% of the Skype and self-recording samples in a random order. 92% of the rescored samples were within 1.5%SS and the remaining samples were within 2.8%SS. Both of the samples with a higher percentage of discrepancy were samples in which disfluency levels were high (i.e., 20%SS, 17.8%SS); therefore, the 2.8%SS discrepancies did not make for dramatic differences in the representation of the data.

Results

Participant A: Percent Stuttered Syllable and Naturalness Ratings

Figure 1 displays the %SS for Participant A during the Skype testing. The figure shows the %SS score for both the monologue conversation tasks. The range of %SS throughout the study was 1.8% and remains within .6% excluding one score within the initial baseline testing. A slight decline during T1 is noted with a slight increase in NT2 and a further decrease in T2. Overall, %SS scores were low for all samples.

Figure 1:

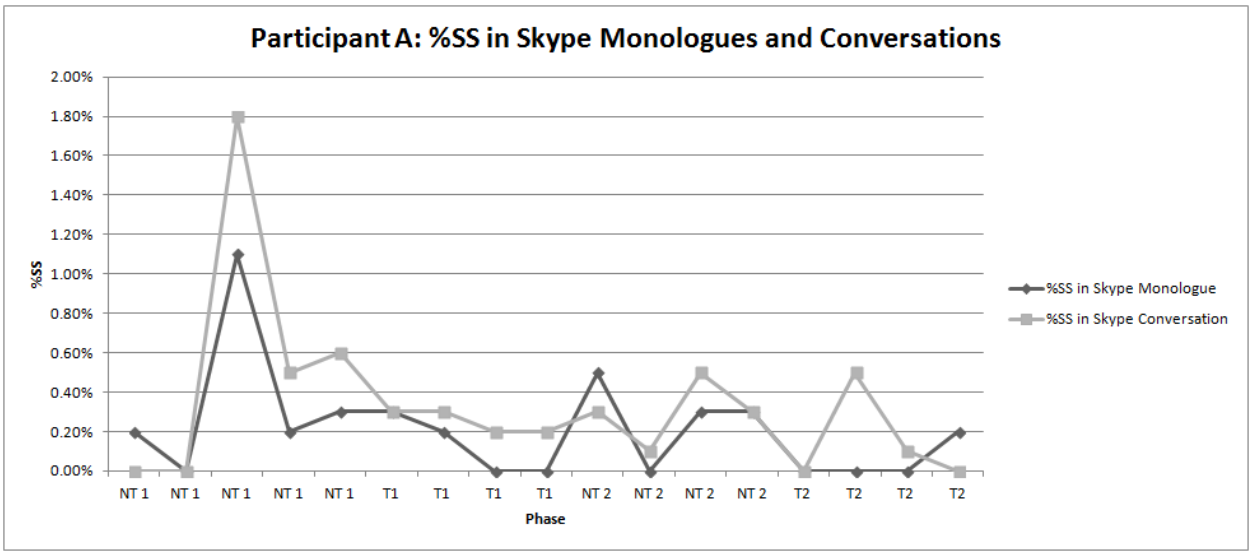


Table 1 displays the average %SS for Skype monologues and conversations during each phase for Participant A.

Table 1: Participant A: Average %SS in Skype Monologues and Conversations.

Phase	Average %SS in Skype Monologue	Average %SS in Skype Conversation
NT 1	0.36%	0.58%
T1	0.13%	0.25%
NT 2	0.28%	0.30%
T2	0.05%	0.15%

Figure 2 displays the naturalness rating for Participant A during the Skype testing. The figure shows the naturalness rating for both the monologue and conversation tasks. A higher score represents an increase in speech naturalness. The naturalness scores reveal an initial

decline during the initiation of T1, an increase during NT2, and an initial decrease at the initiation of T2 with a leveling off of maximum naturalness rating for the remainder of T2.

Figure 2:

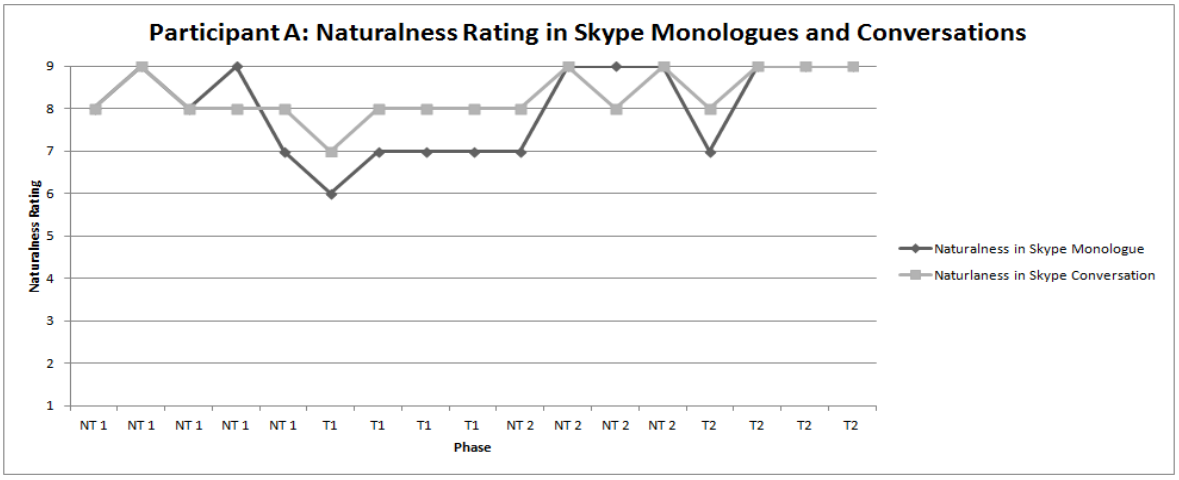


Figure 3 displays the %SS for Participant A during self-recordings. The range of %SS throughout the study was 18%. The %SS scores demonstrate an increase during the baseline testing, initial decrease with later increase during T1, highly variable scores during NT2, and an initial increase during T2 with an eventual decrease during the second half of T2.

Figure 3:

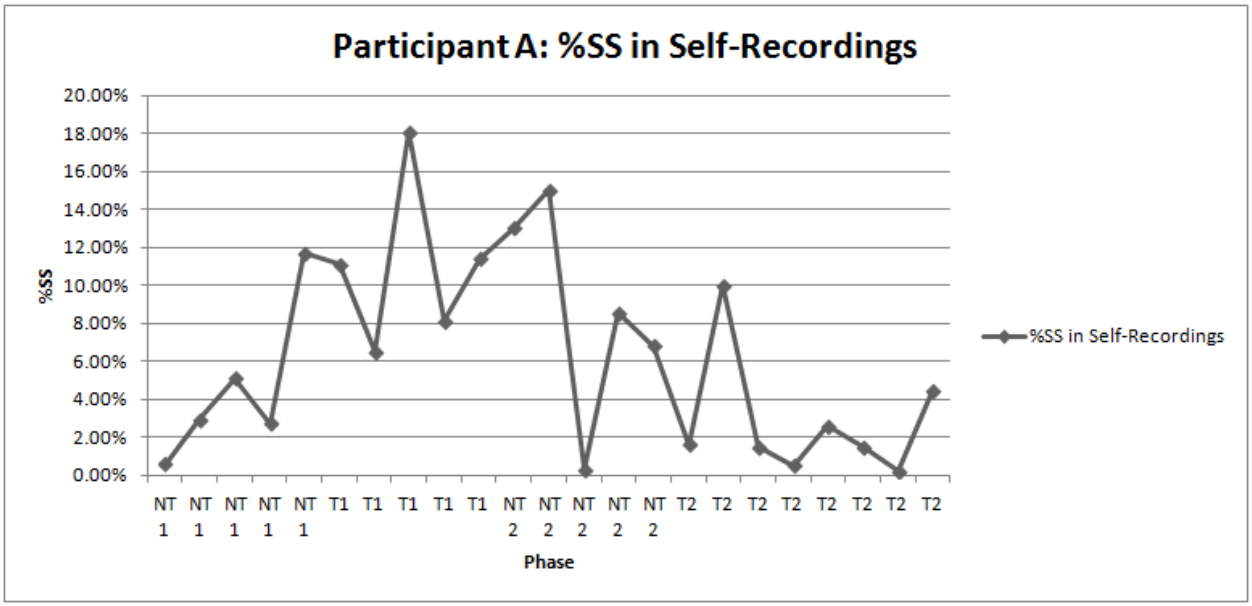


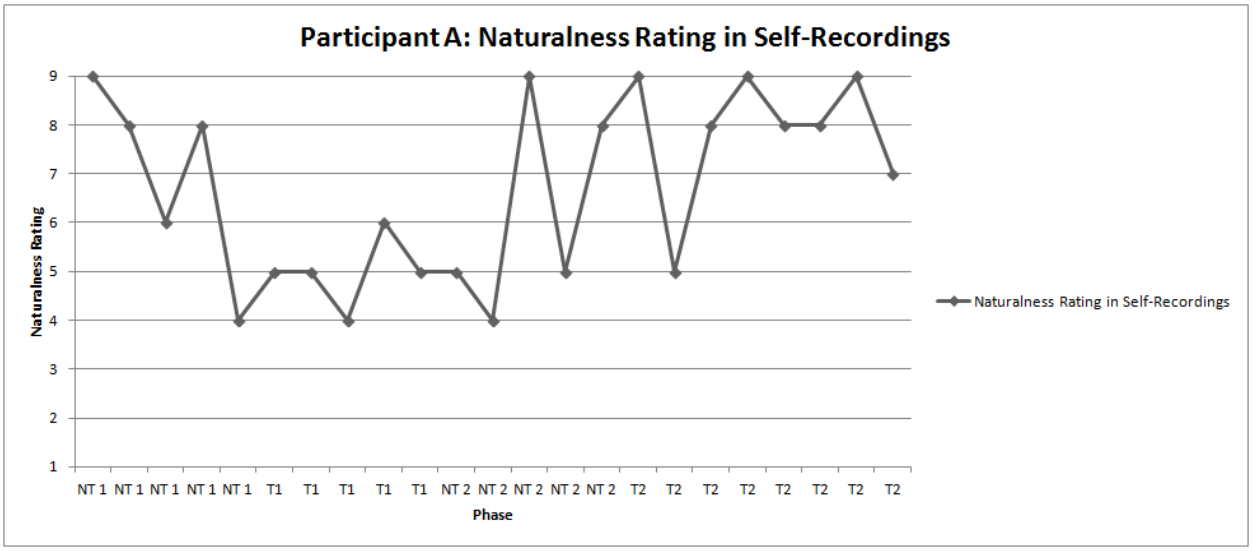
Table 2 displays the average %SS for self-recordings during each phase for Participant A.

Table 2: Participant A: Average %SS in Self-Recordings

Phase	Average %SS in Self-Recording
NT 1	4.60%
T1	11.04%
NT 2	8.73%
T2	2.79%

Figure 4 displays the naturalness rating for Participant A during self-recordings. A higher score represents an increase in speech naturalness. The naturalness scores demonstrate an initial decrease in naturalness during NT1, relatively low but stable scores during T1, highly variable scores during NT2, and an increase in naturalness score during T2.

Figure 4:



Participant B: Percent Stuttered Syllable and Naturalness Ratings

Figure 5 displays the %SS for Participant B during the Skype testing. The figure shows the %SS score for both the monologue and conversation tasks. The range of %SS throughout the study was 3.75%. %SS scores demonstrate a sudden increase and then decrease during T1 with a gradual increase following, variable scores during NT2, and an overall decreasing trend during T2.

Figure 5:

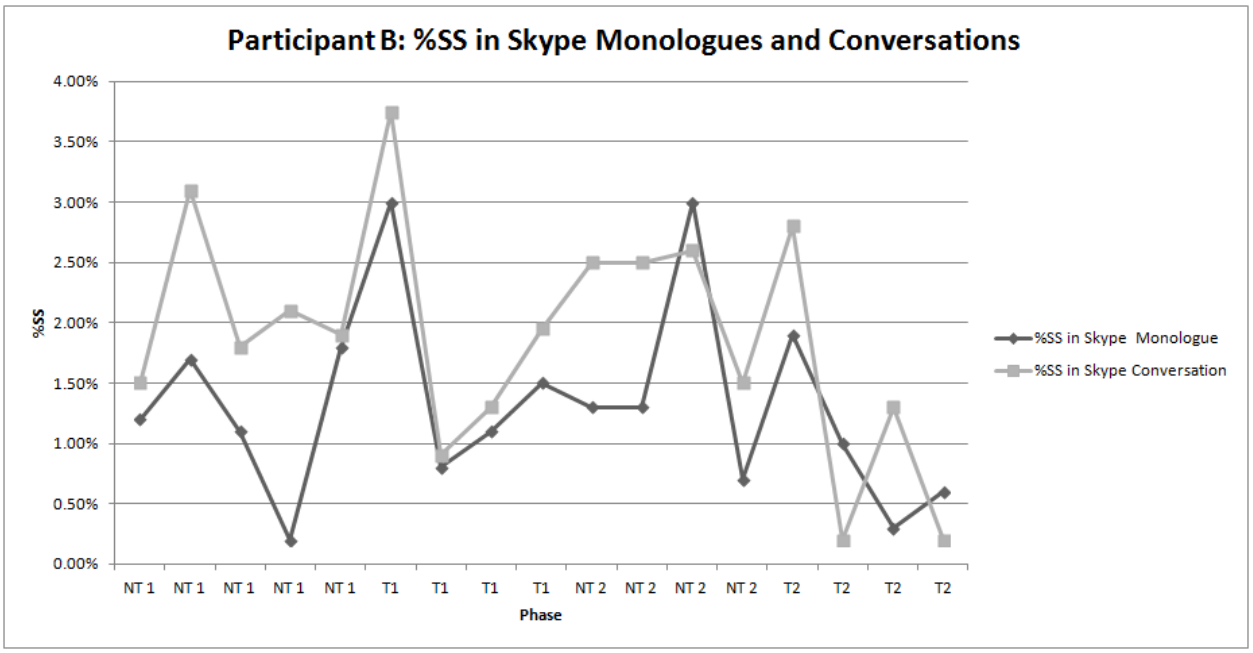


Table 3 displays the average %SS for Skype monologues and conversations during each phase for Participant B.

Table 3: Participant B: Average %SS in Skype Monologues and Conversations

Phase	Average %SS in Skype Monologue	Average %SS in Skype Conversation
NT 1	1.20%	2.08%
T1	1.60%	1.98%
NT 2	1.58%	1.56%
T2	0.95%	0.95%

Figure 6 displays the naturalness rating for Participant B during the Skype testing. A higher score represents an increase in speech naturalness. The figure shows the naturalness rating for both the monologue and conversation tasks. The naturalness scores did not vary greatly throughout the study with an increase and stabilization of scores during T2.

Figure 6:

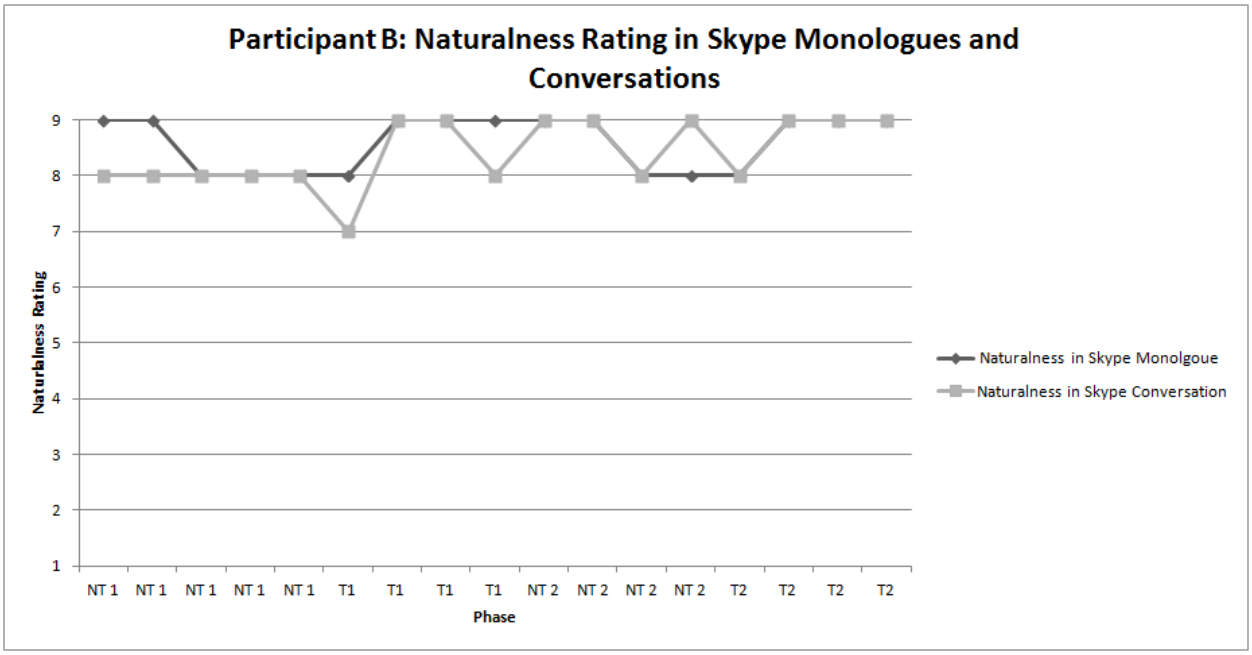


Figure 7 displays the %SS for Participant B during self-recordings. The range of %SS throughout the study was 3.8%. The %SS scores demonstrate relatively high scores during baseline testing, an initial decrease and then increase during T1 with a decrease and stabilization during the second half of T1, an increase at the initiation of NT2 with variable scores, and a decrease with some stabilization during T2. The overall trend of the data is a decrease in %SS scores.

Figure 7:

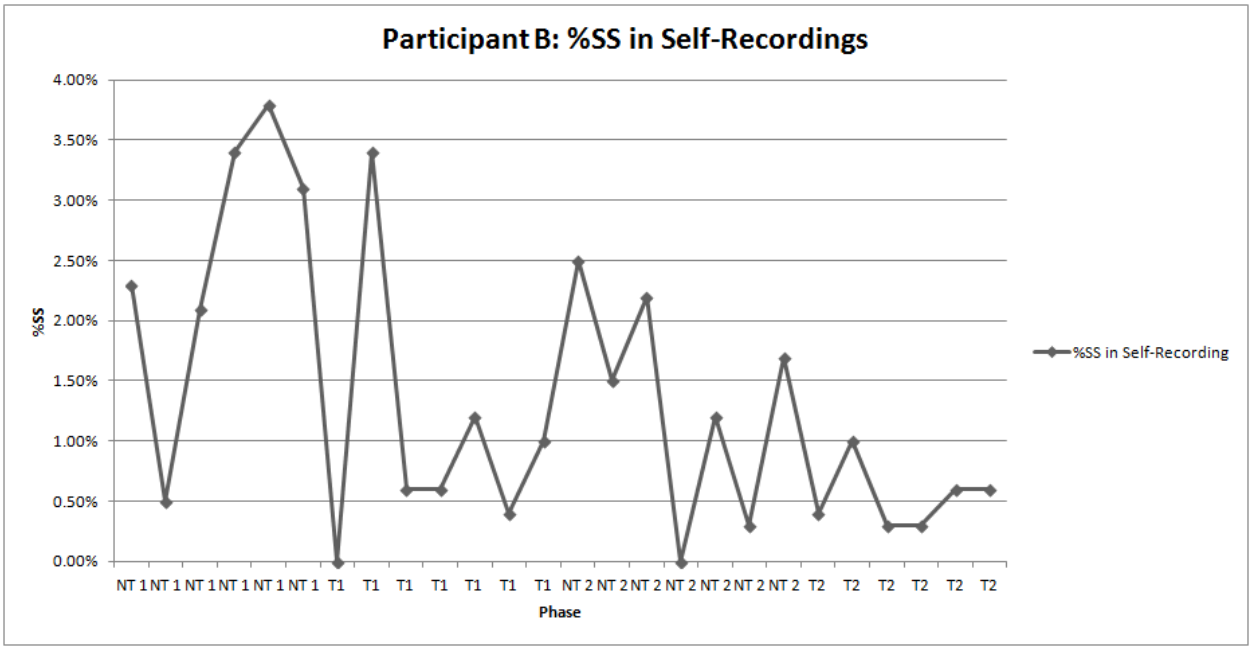


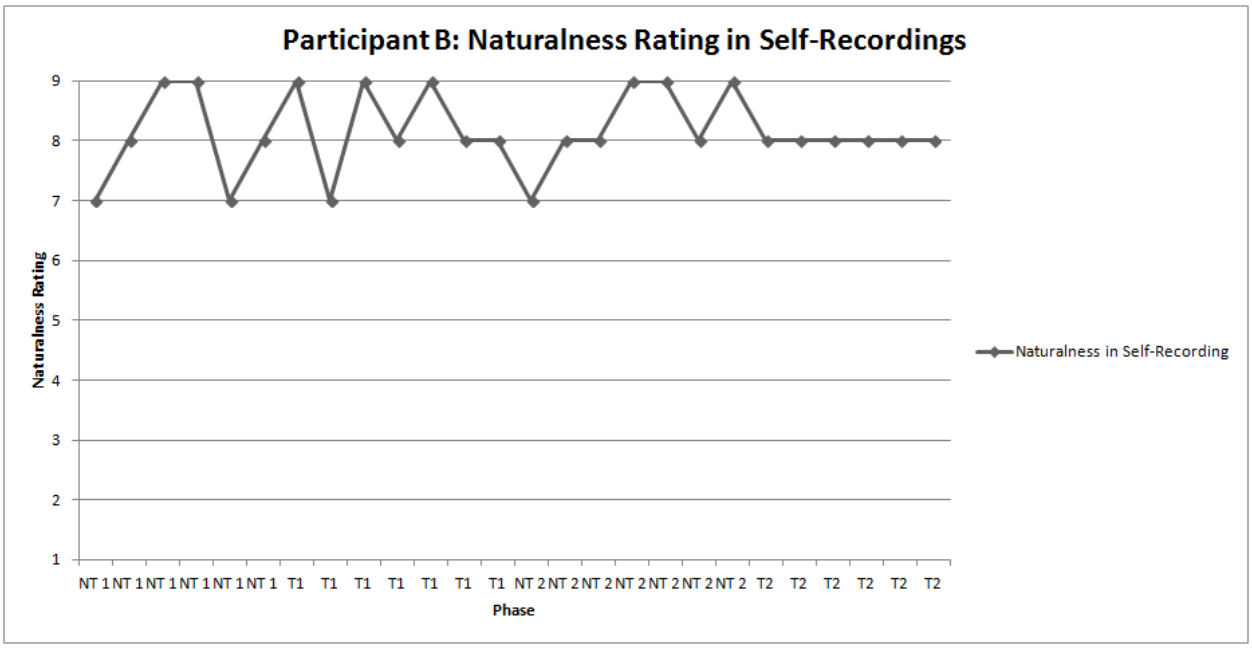
Table 4 displays the average %SS for self-recordings during each phase for Participant B.

Table 4: Participant B: Average %SS in Self-Recordings

Phase	Average %SS in Self-Recordings
NT 1	2.53%
T1	1.03%
NT 2	1.34%
T2	0.53%

Figure 8 displays the naturalness rating for Participant B during self-recordings. A higher score represents an increase in speech naturalness. The naturalness scores demonstrate variable naturalness ratings throughout the first three phases with a stabilization of scores during T2.

Figure 8:



Participant A: Self-Report Scores of Speech Satisfaction, Anxiety, and Stuttering Severity

Figure 9 displays the overall self-rated speech satisfaction score rating prior to each Skype testing session for Participant A. A lower rating represents an increase in overall speech satisfaction. The data demonstrates scores varying between 5 and 7 during the NT1 and T1 phases, an increase during NT2, and a decrease during the second half of T2

Figure 9:

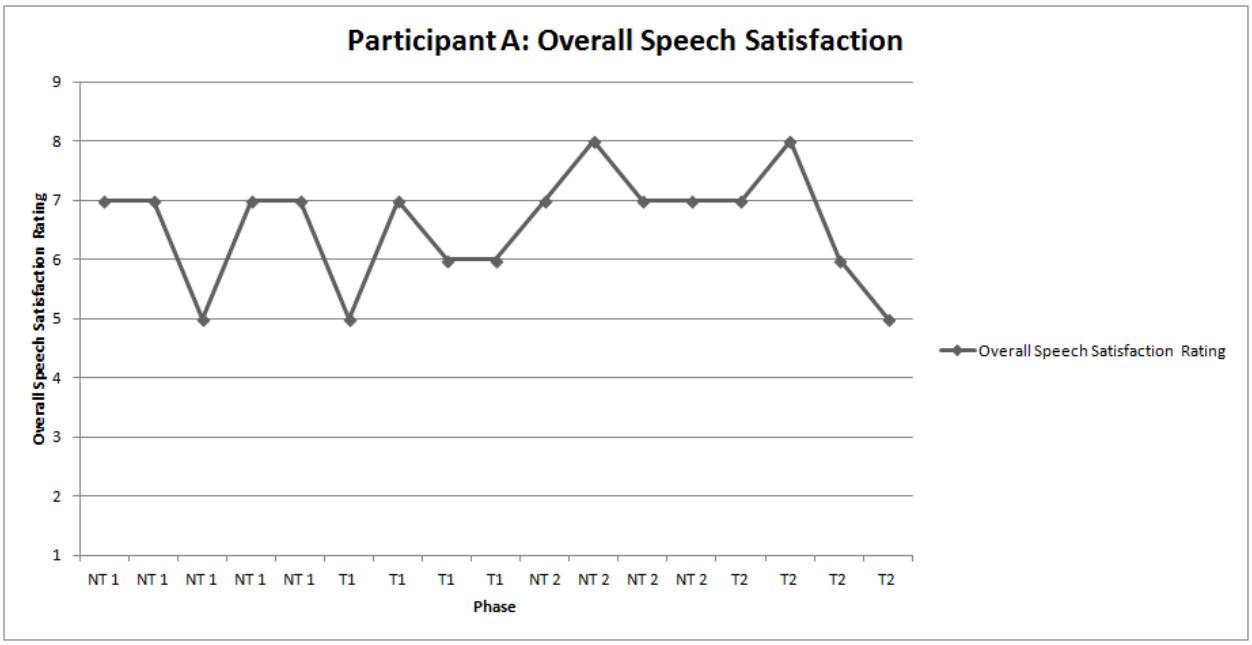


Figure 10 displays the self-rated anxiety rating at the completion of each Skype testing session for Participant A. A higher score represents an increase in anxiety. The data demonstrates a decline during NT1, relatively stable scores throughout T1 and NT2, and an initial increase and then decrease during T2.

Figure 10:

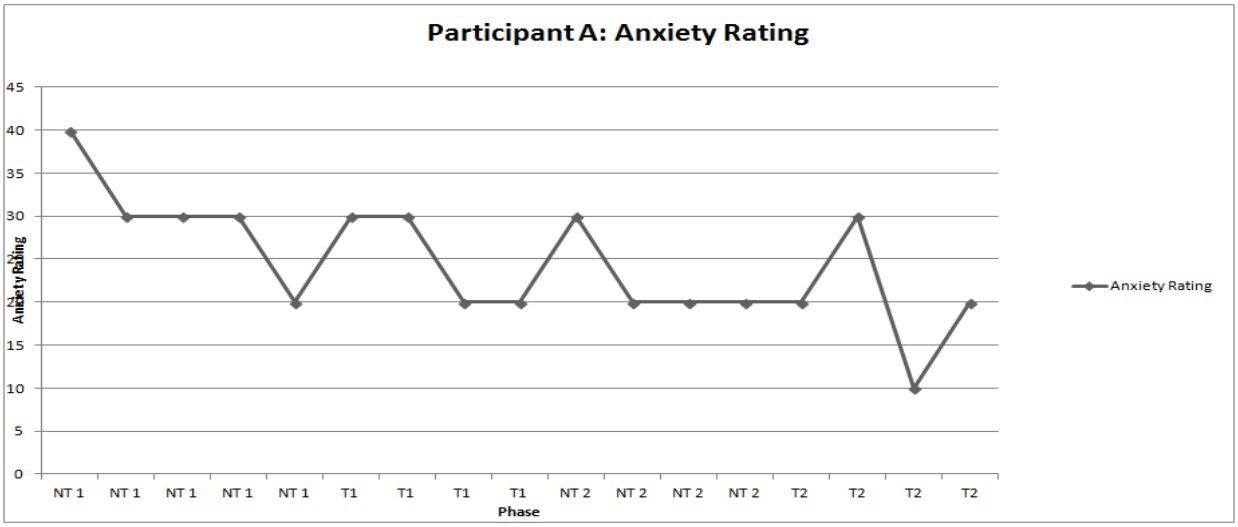
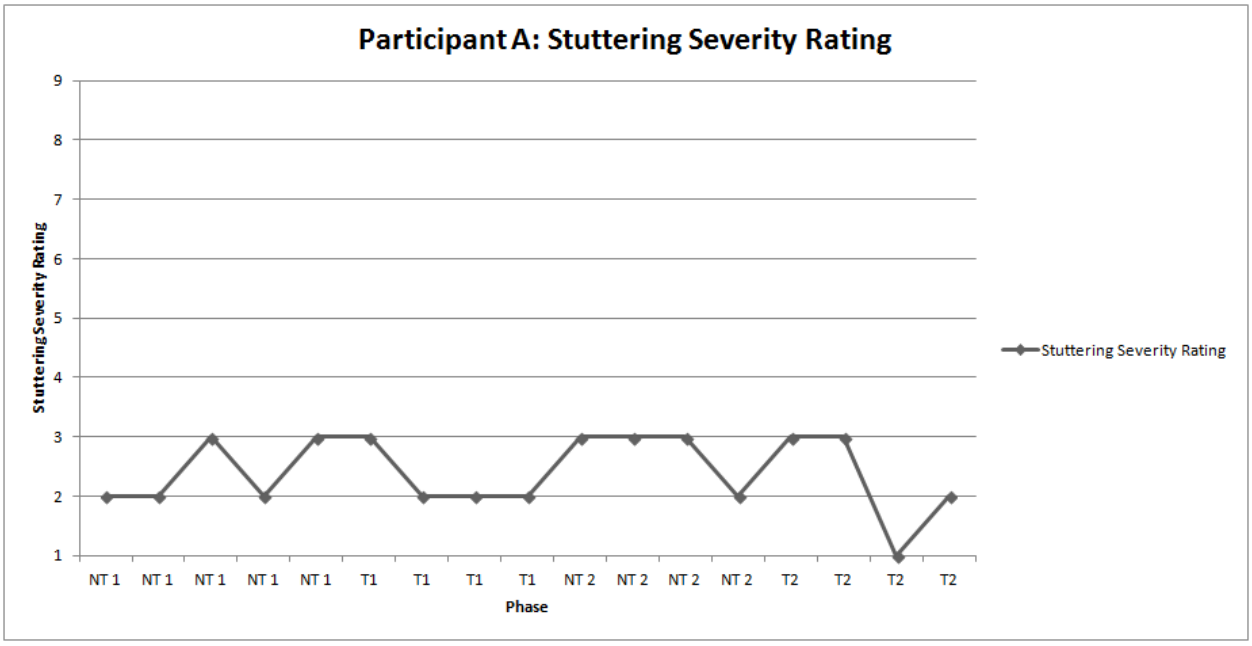


Figure 11 displays the self-rated stuttering severity rating at the completion of each Skype testing session for Participant A. A higher score represents an increase in stuttering severity. The data reveals a relatively stable severity rating ranging between 2 and 3 throughout the first 3 phases of the study with a decrease during the second half of T2.

Figure 11:



Participant B: Self-Report Scores of Speech Satisfaction, Anxiety, and Stuttering Severity

Figure 12 displays the self-rated overall speech satisfaction score rating prior to each Skype testing session for Participant B. A lower rating represents an increase in overall speech satisfaction. The data demonstrates a decrease in rating during T1 with stabilization of that rating throughout NT2 and T2.

Figure 12:

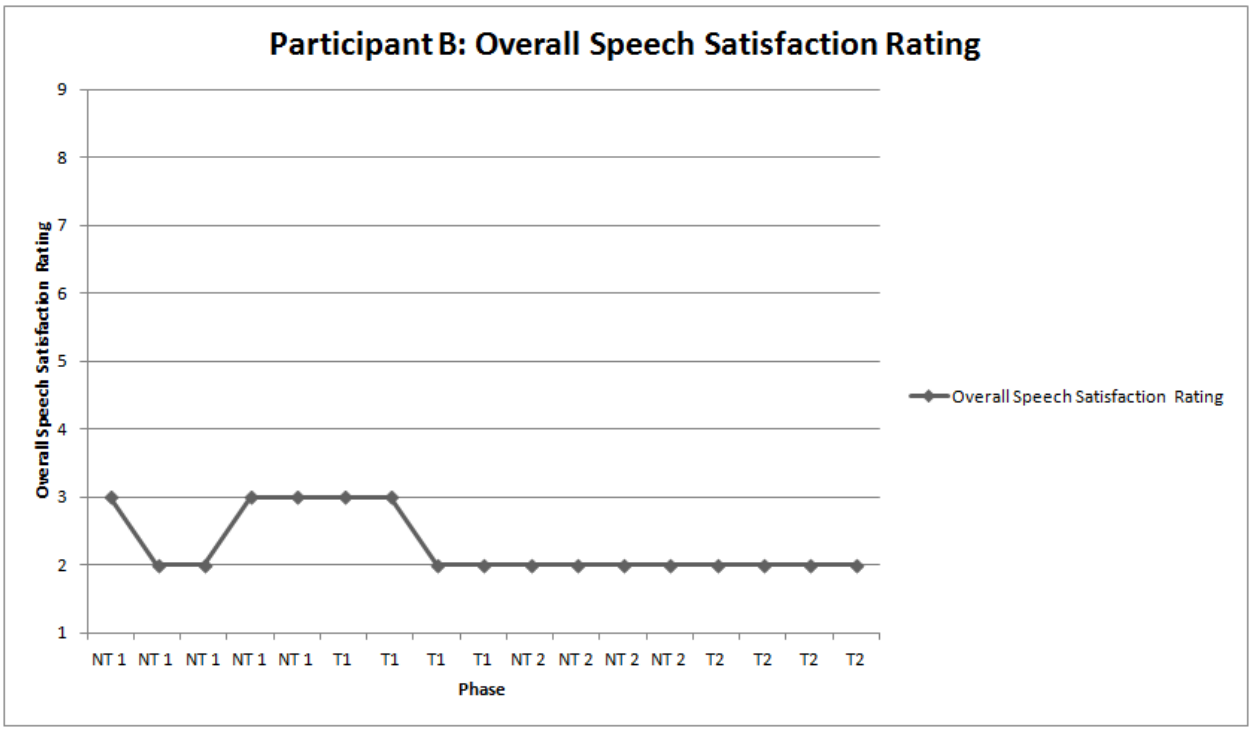


Figure 13 displays the self-rated anxiety rating at the completion of each Skype testing session for Participant B. A higher score represents an increase in anxiety. The data demonstrates a decline during NT1 and relatively stable scores throughout T1, NT2, and T2.

Figure 13:

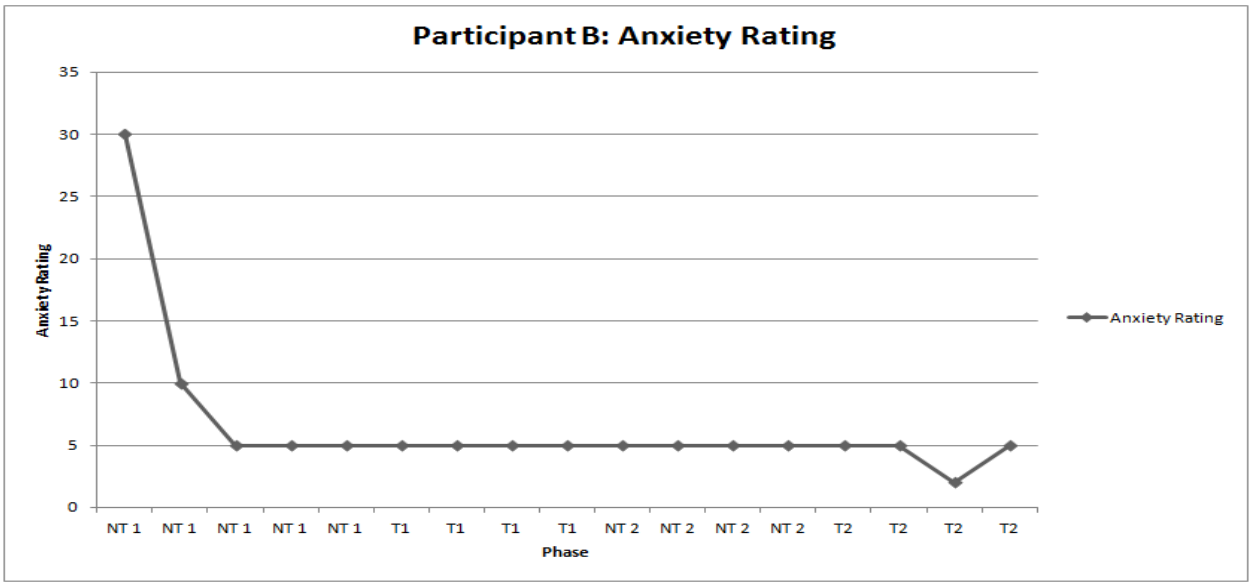
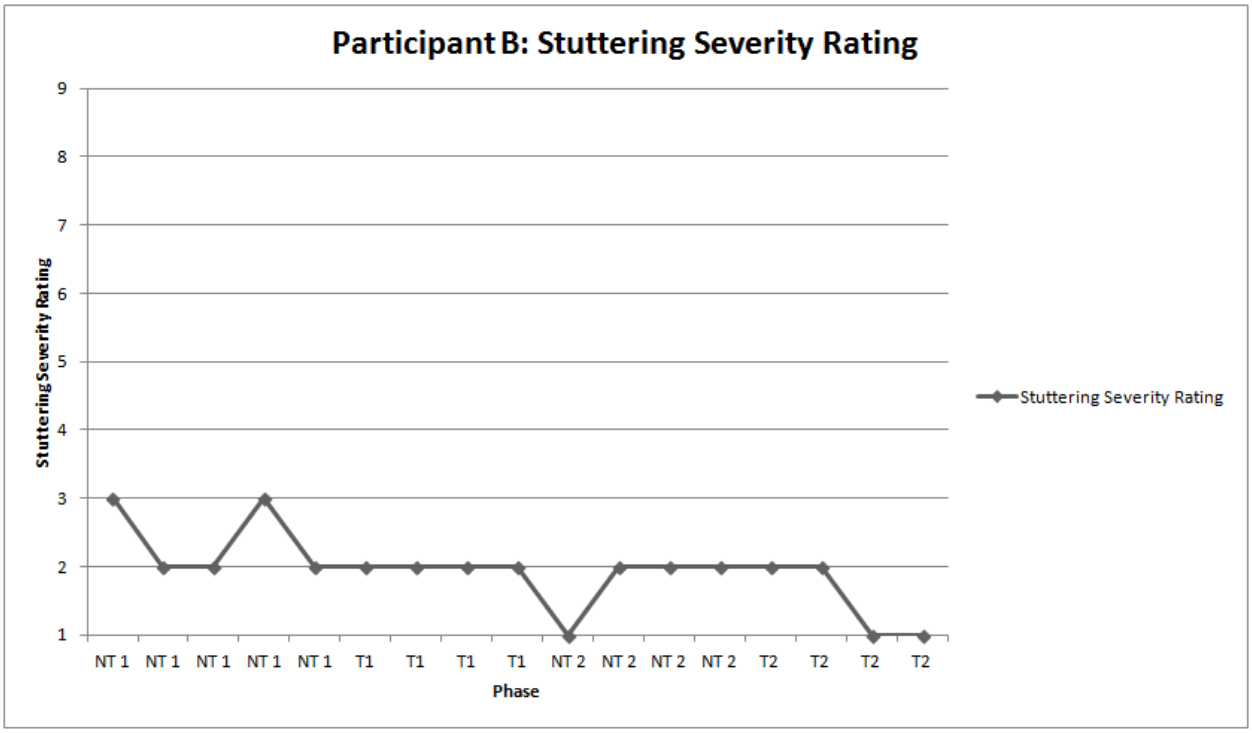


Figure 14 displays the self-rated stuttering severity rating at the completion of each Skype testing session for Participant B. A higher score represents an increase in stuttering severity. The data reveals a relatively stable severity rating ranging between 3 and 2 throughout the first 3 phases of the study with a decrease during the second half of T2.

Figure 14:



Participant A: OASES Scores

Figures 15, 16, and 17 display the results of the specific sections of the OASES that were completed by Participant A. A lower scores represents a decrease in the negative impact stuttering has on the participant's life. All three figures demonstrate a decline during T1, an increase at the initiation of NT2, and an overall decline during the second half of NT2 and T2. Participant A's overall score for the full OASES at the initiation of the study was 3.14 which places her in the moderate/severe range. Her overall score for the completion of the full OASES at the conclusion of the study was 2.85 which places her in the moderate range

Figure 15:

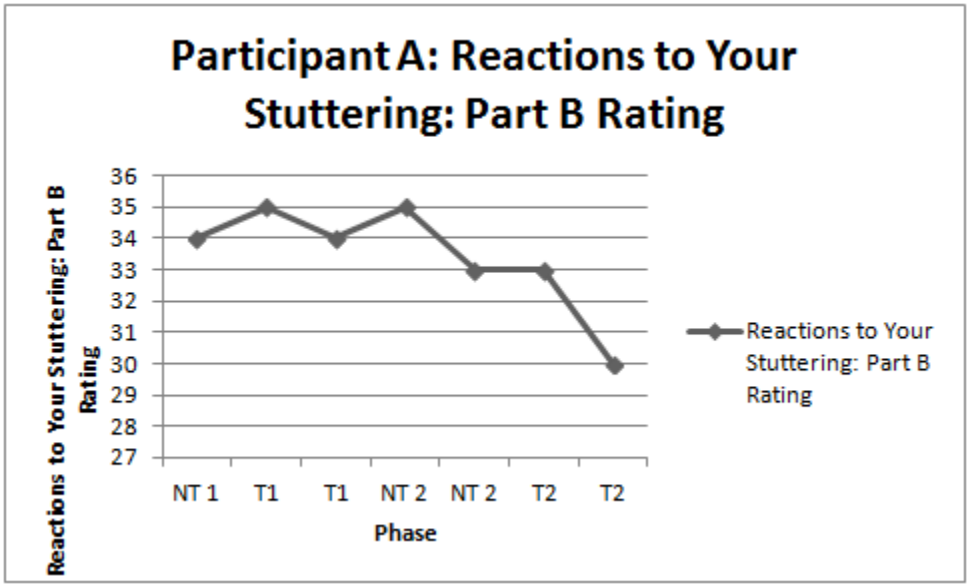


Figure 16:

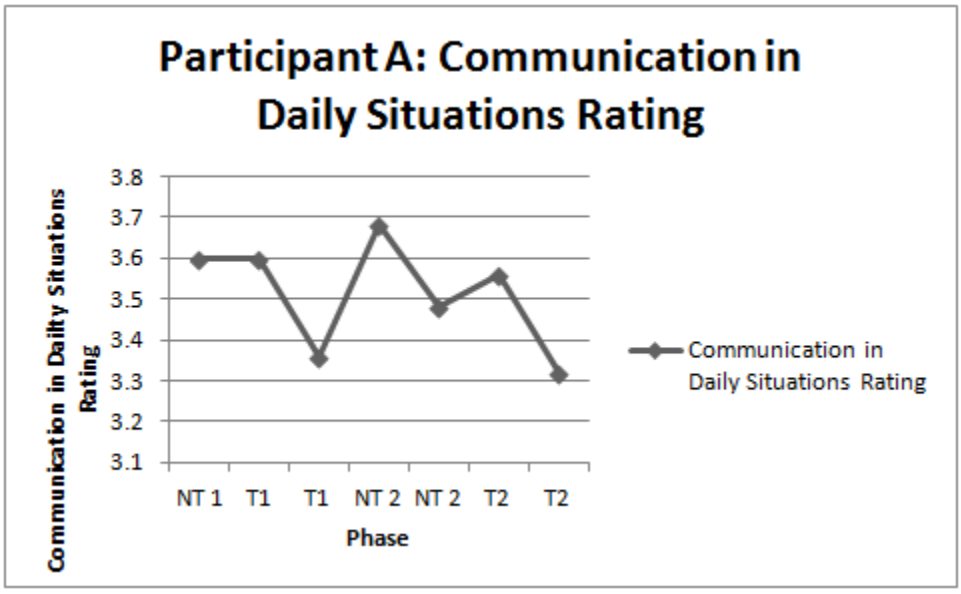
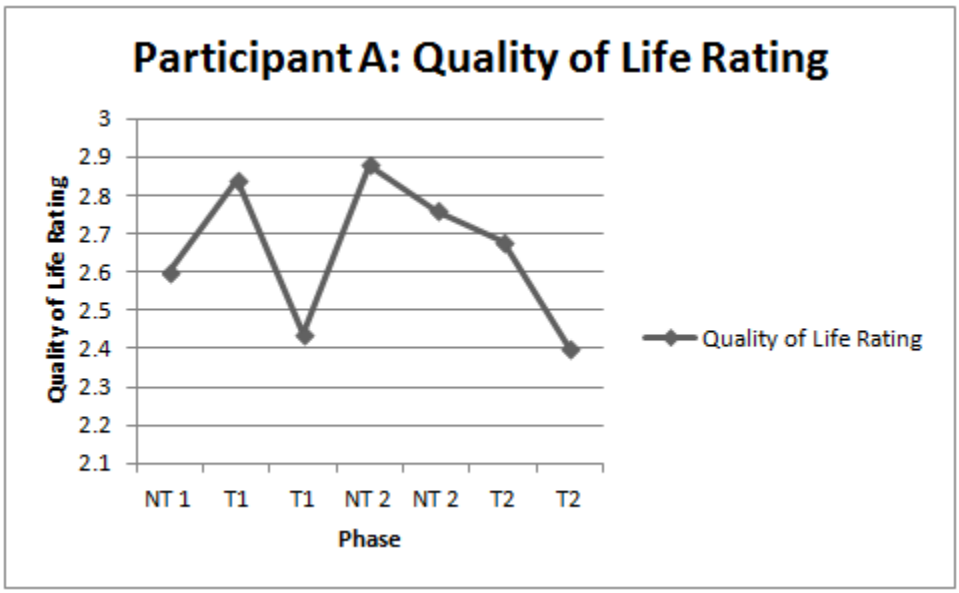


Figure 17:



Participant B: OASES Scores

Figures 18, 19, and 20 display the results of the specific sections of the OASES that were filled out by Participant B. A lower scores represents a decrease in the negative impact stuttering has on the participant's life. All three figures demonstrate relatively stable scores throughout the first 3 phases, with a decrease in score during T2. Participant B's overall score for the full OASES at the initiation of the study was 1.79 which places her in the mild/moderate range. Her overall score for the completion of the full OASES at the conclusion of the study was 1.47 which places her in the mild range.

Figure 18:

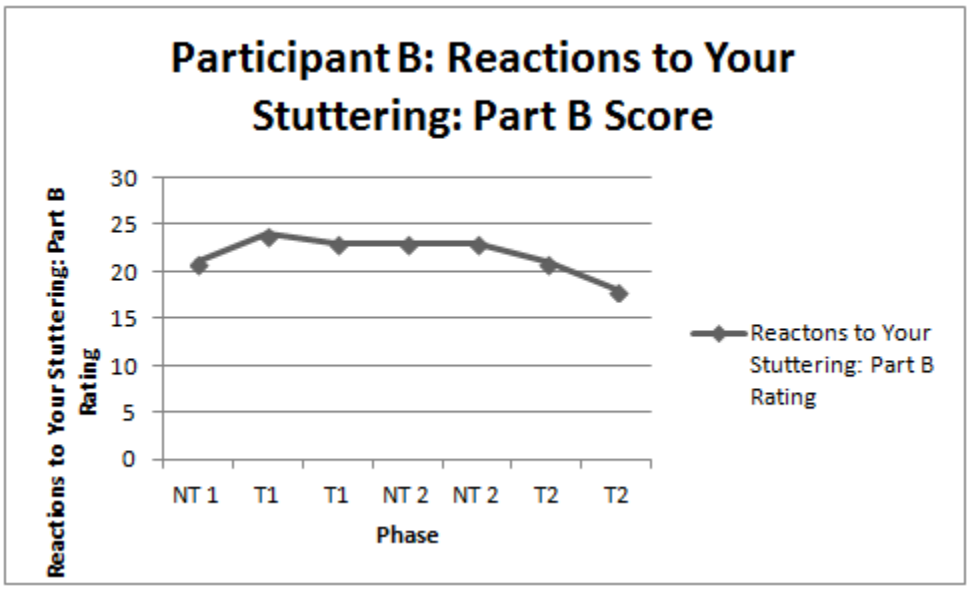


Figure 19:

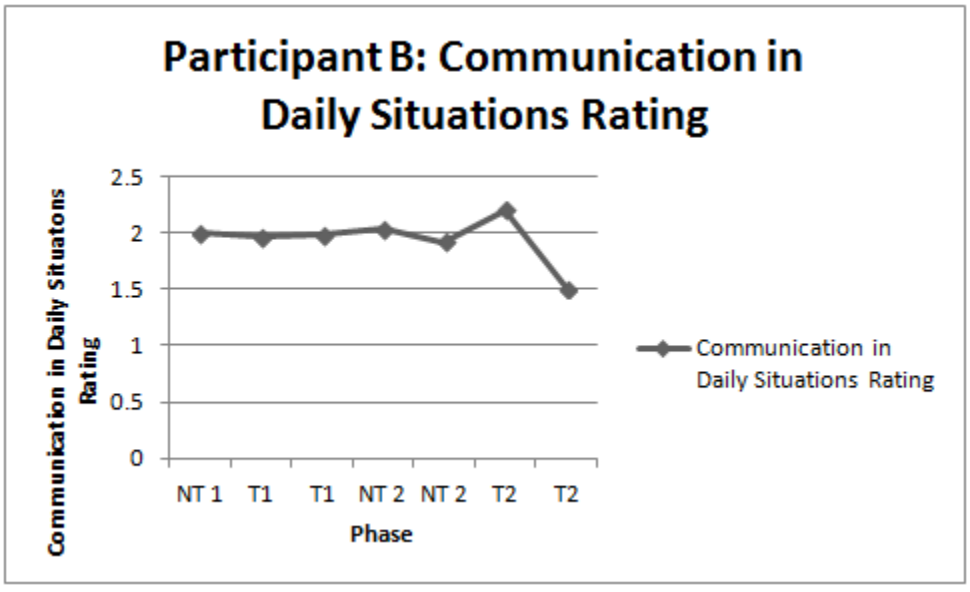
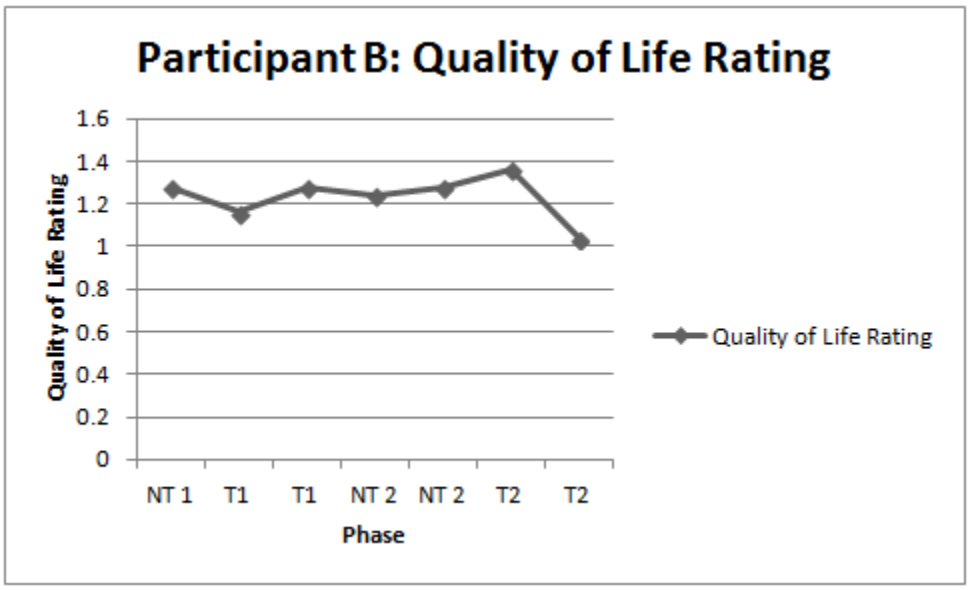


Figure 20:



Exit Interview

At the conclusion of the study, an exit interview was conducted with both participants to obtain information about their thoughts on their own performance throughout the study and their opinion on how treatment was conducted.

Participant A reported that compared to her communication prior to the study, she has more control over her ability to use easy speech to maintain fluency. She informed the research clinician that she still needs to work on not panicking when she is having trouble in higher-challenge situations, stopping when she is having difficulty and regaining control, and thinking about using the skills she has learned in those situations instead of what the other person is thinking about her. Participant A reported that she is more fluent in previously avoided situations such as asking questions, going through drive-through restaurants, and talking during meetings. She is better able to successfully use controlled fluency in many situations but still needs practice during higher-challenge conversations. Participant A informed the research clinician that she can now count on using fluency skills when calling her mother, when speaking with her husband and

boys, when speaking in class, when speaking in meetings, and when speaking with friends. She stated that using easy speech is now more of a habit and she has seen an increase in her confidence. Overall she reported that she liked the treatment process, enjoyed the ability to conduct a majority of the sessions over Skype, found functional phrases useful in everyday life, and felt that she received the right amount of support for success. She would have preferred more practice using fluency shaping skills face to face with strangers in person. An SSI-4 was completed during the exit interview and the client produced speech both in conversation and reading aloud with less than .5% SS and no physical concomitants which places her below the "very mild" severity rating on the SSI.

Participant B reported that compared to her communication prior to the study, she is more knowledgeable about stuttering, more aware of her own stuttering, has more control when speaking, has an easier time predicting when she will have difficulty, is more open to talking about her stuttering, and knows how to prepare for difficult speaking situations. She stated that she still needs to practice using easy speech so that she does not have to think about it as much when speaking. Participant B reported that she is more spontaneously fluent with friends and family and that she has noticed a big difference in her fluency overall. She informed the research clinician that she is better able to successfully use controlled fluency in high-challenge situations, such as raising her hand in class and giving presentations. Participant B reported that she can now count on being able to use fluency skills when giving presentations, talking in front of small groups of people, and raising her hand in class. She stated that the biggest changes in her communication have been her level of fluency, her perspective and knowledge about stuttering, and her more positive outlook on speaking related to feelings of increased control over her own speech. In terms of the treatment procedures, she stated that she thought it was a positive

experience, she liked therapy occurring for 50-minutes each weekday, she thought treatment was useful and based on what she needed, and she liked the way that target complexity built up over time. Her major complaint about treatment had to do with the testing that was required for the study and the repetitiveness of practicing the functional phrases. An SSI-4 was completed during the exit interview and the client produced speech both in conversation and reading aloud with less than .3% SS and no physical concomitants which places her below the "very mild" severity rating on the SSI.

Discussion

The purpose of this study was to examine the efficacy of intensive stuttering therapy that incorporates telepractice and what is known about motor learning and neuroplasticity. Outcome measures were used to assess the disfluency levels and quality of life of two adults who stutter. The data revealed an overall decrease in average %SS in self-recordings by the conclusion of the second treatment phase and an improvement in scores on the OASES. High variability of individual data points was noted throughout the study. This was likely related to the difficulty in obtaining consistently representative data for individuals who stutter due to the myriad of factors that contribute to when and how disfluencies occur. This variability of data points decreased as the study progressed which further demonstrated the efficacy of the treatment program. The exit interviews at the conclusion of the study suggest that the participants believe the therapy administered was beneficial and resulted in improvement in their fluency.

Data for %SS and naturalness for Participant A was drastically different between the Skype testing and the self-recordings. The %SS during both the monologue and conversation tasks over Skype remained relatively low throughout the study. This is most likely related to the fact that Participant A had received previous therapy as an adult and was able to switch into the

use of fluency shaping skills whenever she was in a speech treatment setting. After her initial difficulty during the pre-treatment interview, Participant A consistently used fluency shaping skills to maintain fluency during treatment sessions. Skype treatment sessions were deliberately set up to increase the communication pressure and make the participants not feel like they were in the "safe" atmosphere of a treatment sessions (i.e., research assistants were asked to deliberately remain neutral during conversations, read repetitive and formal sounding instructions, and interrupt, disagree, and ask for clarification during conversations). However, both participants noted during the exit interview that they did not feel a particular increase in communication pressure during the Skype testing sessions. This failure to simulate communication pressure is likely the reason for Participant A's low %SS throughout the study during Skype conversations and monologues and therefore the data was not consistent with data collected in more typical, everyday conversation. Despite the small levels of disfluency noted during these Skype testing sessions, the average %SS for each phases does reveal a decrease during T1, a small increase during NT2, and another decrease during T2, which suggests that treatment likely had an impact on decreasing the disfluency levels during Skype testing sessions. The data for the naturalness rating during Skype testing sessions does appear to show some notable change throughout the study. There is a sudden decrease in naturalness at the onset of T1 which is likely related to a sudden focus on the purposeful use of fluency shaping skills. As the phases progress, the data shows that Participant A's naturalness rating increases again and the last three data points for both conversations and monologues show her naturalness rating at the highest possible score. This suggests that as Participant A had more practice using fluency shaping skills, her speech while using these skills became more natural; therefore, the use of

fluency shaping skills not only reduced her %SS, but also led to speech that sounded natural to conversation partners.

The data for %SS for Participant A during self-recordings reveals far more useful information related to her fluency levels during high-challenge situations in her natural environment. The data shows relatively low levels of %SS throughout the first four data points in NT1. As reported by the participant, this is likely related to the limited availability of higher-challenge speaking situations. Data for NT1 was collected on consecutive days and therefore it was difficult for both participants to place themselves in high-challenge speaking situations consistently for four days in a row. Both participants were also learning how to use the self-recording device and becoming comfortable recording themselves. Unfortunately, these low scores during NT1 skew the perceived improvement Participant A reported between the initiation of treatment and the conclusion of treatment during the exit interview. The first treatment phase revealed consistently high %SS scores throughout with no clear sign of improvement. This is likely related to two factors. First, %SS scores will naturally vary to a certain extent due to the fact that stuttering and levels of disfluency vary depending on many factors, not just on the perceived challenge level of a situation. The second factor related to the high levels of disfluency during T1 is that treatment was structured to build skills from the bottom up. Treatment exercises and home practice activities were conducted at a level that ensured that participants were successful; therefore, treatment built from the lowest challenging speaking situations to the highest challenging speaking situations. During T1, treatment had not yet reached practice during high-challenge speaking situations and therefore the participant would not be expected to improve significantly during the high-challenge speaking situations that were recorded. Data during NT2 continues to show relatively high levels of disfluency excluding one data point. T2

shows a drastic improvement in disfluency rates when compared to T1. With the exception of one data point, all of the data remained below 5% SS which is most likely related to the fact that during T2, home practice activities and treatment exercises had begun to focus on moderate to high-challenge speaking situations. The data reveals clear evidence that during T2, the participant is producing less disfluencies during high-challenge speaking situations with an average %SS score of 2.79% when compared to 11.04% in T1. When looking at the average %SS for each phase, the average %SS scores gradually decreases after T1. Naturalness ratings for Participant A follow a similar trend to the disfluency levels seen in the self-recordings. The naturalness rating data supports the idea that by T2, the participant is not only producing less disfluencies overall, but is also producing speech that conversation partners would rate as being highly natural.

Data for %SS and naturalness ratings for Participant B are much more consistent between Skype testing sessions and self-recordings when compared with Participant A. %SS scores for both the Skype testing and self-recordings show the variability in disfluency found in many individuals who stutter. The data reveal that Participant B is more disfluent in conversation than in monologue, which is what one would expect due to the increased communication pressure typically found in conversations. The average %SS scores for Skype conversations shows a gradual decrease in %SS as treatment is implemented. Average %SS scores remain somewhat stable during NT2, T1, and NT2 and then a decrease is noted during T2 when the average %SS score drops to .95%. The data for the Skype monologues shows an increase in the average %SS after the NT1 and then follows a pattern similar to the conversations in which %SS numbers remain somewhat stable until T2 at which time a decrease is noted. This patterns reveals an overall decrease in %SS by the last treatment phase for both conversation and monologues.

Although individual data points are highly variable, this variability decreases as the study progresses which further suggests that treatment is having an effect on Participant B's ability to maintain increased fluency. Naturalness rating scores follow a pattern similar to what was found in the data for Participant A. A decrease in naturalness rating is noted at the initiation of treatment which is likely related to purposeful focus on the use of fluency shaping skills and by the end of the T2, naturalness scores have stabilized and are consistently rated at the highest possible score.

Data for %SS in self-recordings continue to be highly variable. When looking at the average %SS scores in each phase, the improvement that was made throughout the study becomes clearer. The average %SS scores for each phase reveals a significant decrease in %SS scores during T1, a small increase during NT2, and then a significant decrease during T2. When looking at the average %SS scores, the pattern reveals strong evidence that the treatment implemented was the variable that led to increased fluency for Participant B. There is significant variability of individual data points and the presence of extreme outliers (e.g., a 0% SS score was obtained during NT2), but this variability decreases as the study progresses. The naturalness ratings reveal a variable pattern throughout most of the study ranging from a perfect score of 9 to a score of 7; however, the scores stabilize during T2 in which the last six scores were all 8. This is likely related to the participant's increased use of fluency shaping skills during these self-recordings. The participant is more successfully maintaining fluency by the end of the last treatment phases but more practice is needed to ensure that the use of fluency shaping skills are not leading to a speech pattern that would still be considered unnatural to conversation partners even with the lack of actual disfluency.

The data for the three self-reported ratings for Participant A reveal some change throughout the study. The stuttering severity rating scores show the least amount of change throughout the study and are not representative of everyday communication. This is likely related to the fact that %SS scores for Participant A during Skype conversations were relatively low; however, it is interesting to note that she consistently rated herself a 2 or 3 with the exception of one data point even though %SS rates were low enough that the research clinician would likely rate her speech a 1 on almost all data points. Due to the lack of communication pressure imposed by the format of the Skype testing, the data for anxiety likely does not represent anxiety levels in everyday conversation. The data shows a slight decrease in anxiety levels from the initial Skype testing, as one would expect when doing something unfamiliar, and then anxiety levels range from 30-20 until the second to last Skype testing session. The overall speech satisfaction rating is the most meaningful of the three self-reported ratings which is likely related to the fact that this rating did not directly involve the testing session itself. The data shows a range of scores throughout NT1 which is likely related to specific events or situations that were encountered each day due to the fact that baseline testing was conducted on consecutive days; therefore, the participant is likely rating her satisfaction each day rather than a more overall satisfaction. A slight increase in rating is noted, which means a decrease in speech satisfaction and then lower scores during T2, but the rating never reaches a point lower than what was found in the baseline. Participant A reported during the exit interview that her ratings for this outcome measure and similar measures found on the OASES may be skewed due to the fact that she was expecting more of herself by the end of the study. As she practiced more, she expected herself to do better in even harder situations than she previously had and therefore her scores on these measures may not adequately represent the amount of improvement she felt she had made throughout the study.

The self-reported ratings for Participant B show little to no change throughout the study. The anxiety rating scores shows the most dramatic change of the three but, once again, is likely related to the participant being more anxious about doing something new. Following the initial decrease, complete stabilization of scores is achieved as the Skype testing process becomes familiar. The stuttering severity self-reported rating scores match somewhat consistently with the %SS scores achieved during Skype testing sessions with relatively stable scores at the low end of severity rating throughout with slightly higher scores during NT1 and slightly lower scores during T2. Surprisingly, overall speech satisfaction self-reported ratings remain stable throughout NT2 and T2 despite significant improvement in disfluency rates during T2. This may be related to the fact the Participant B would be considered a "mild" stutterer in a majority of speaking situations and higher-challenge speaking situations in which her disfluency rates increase dramatically are more rare. Participant B's satisfaction ratings are relatively low, meaning highly satisfied, since the initial baseline and therefore there was not much room for improvement throughout the study.

Scores taken from the OASES for Participant A would show strong evidence for treatment as the determining factor for the improvement seen throughout the study; however, the low number of data points for this outcome measure in each phase make it difficult to draw strong conclusions. Both scores in Figure 16 and Figure 17 show a decrease in score during T1, an increase during NT2, and a decrease in T2; however, the lowest scores during T2 are not much lower than the lowest score during T1 which suggest that one treatment phase was all that was necessary to improve the rating on these two outcome measures. This also suggests that this improvement may not last after the conclusion of treatment due to the fact that scores changed so rapidly during NT2. The scores in Figure 15 show a different pattern. Instead of displaying

sudden changes between phases, a more gradual decline is noted until there is significant improvement by the last data point in T2. At the beginning of treatment, Participant A's score for the complete OASES placed her in the moderate/severe range and at the conclusion of the study, her score placed her in the moderate range, which suggests that some improvement was made; however, the participant's daily life continues to be moderately impacted by her stuttering. It is likely that Participant A would benefit from a treatment program with more of a focus on her emotional/reactive responses to her stuttering. The participant greatly improved her ability to use fluency shaping skills in higher-challenge situations to maintain fluency when supported by the clinician, but she continued to struggle to apply those skills in real life high-challenge situations. A treatment model that equally addresses both emotional reactions and behavioral modifications is likely to be more beneficial overall for clients who have severe stuttering and strong emotional reactions to their disfluency.

All of the scores taken from the OASES for Participant B show a similar pattern. Scores remain relatively stable until the last data point during T2 in which a decrease is noted. At the initiation of treatment, her scores on the OASES placed her in the mild/moderate range and by the end of the study, she scored in the mild range. The treatment program that was implemented for Participant B appears to have been highly successful in the treatment of her stuttering. Treatment focused on behavioral modifications with continued repetitious practice appears to be a successful strategy in the treatment of clients who have a mild form of stuttering and do not have strong emotional reactions or avoidance behaviors as a result of their stuttering.

Both participants reported that they enjoyed the convenience of participating in sessions over Skype. There were relatively few difficulties with Skype throughout the study. On a few occasions, Participant B's internet connection led to up to 20 minutes of lost time during

treatment sessions attempting to reestablish a strong connection. During the early phases of treatment for Participant B, the sound quality at times made it difficult to provide appropriate feedback about fluency shaping skills, such as easy onset of phonation and light articulatory contacts. The research clinician enjoyed having the ability to conduct treatment over Skype because it allowed sessions to occur outside of normal clinic hours and treatment was able to be conducted in locations other than the clinic when necessary. The research clinician feels that he was able to successfully conduct treatment in a way that was consistent with what would be done in person; however, it was still necessary to conduct at least one session a week in person so that materials could be shared.

Limitations

This is a single-subject design study and therefore the findings are limited in generalizability. A more thorough investigation of the efficacy of this therapy program will need to be tested in a larger group design study with the appropriate number of control subjects.

The most obvious limitation of the current study was the failure of the Skype testing sessions to simulate increased communication pressure in order to get a consistent measure of the participants' speech in a controlled and reproducible high-challenge situation. Skype testing sessions were conducted by the two research assistants involved in the study; therefore, the participants quickly grew accustomed speaking to the same two people each week, which likely contributed to the decrease in communication pressure. In order for the research clinician to adequately create a consistently high-challenge speaking situation, a new research assistant would have been required for nearly every Skype testing session which would not have been feasible at the time of the study. Also, the participants were completing these testing sessions from the comfort of their home. Requiring the participants to complete the testing in person and

in a place separate from where therapy was being conducted would likely have been sufficient to create a reproducible and consistently high-challenge speaking situation.

Due to the lack of communication pressure present during Skype testing sessions, a majority of the valuable data came from the participants' self-recordings, which also had its limitations. The participants were asked to record themselves in high-challenge conversations in their daily life; however, these high-challenge situations changed week to week depending on the situations available to each participant. Two recordings were not reliably collected each week for various reasons including a lack of appropriate situations, busyness of a particular weekend, or forgetting to record high-challenge situations when they occurred naturally. Also, throughout the study the participants gained more confidence as they continued to practice fluency shaping skills and therefore may have become more willing to place themselves in even higher-challenge situations as the study progressed. This meant that the participants may have been initially recording themselves in situations that by the end of the study they may have considered more moderate or low-challenge situations due to their increased confidence and willingness to place themselves in higher-challenge situations. This was most likely the case for Participant A in particular as she mentioned in her exit interview.

Another limitation of the study involved the collection of the self-ratings. ABAB withdrawal studies require at least three points of data for each phase of the study. This meant that participants needed to complete self-ratings every week. The number of times that participants had to rate themselves may have lead to a decrease in the ability of the participants to correctly judge any change. If the participants were asked to self-rate at longer intervals when more change was likely to have happened since their last rating, a larger difference may have been noted. Instead, small changes likely occurred each week that were not enough to convince

the participant to change the rating and therefore they remained relatively consistent throughout most of the study.

One last small limitation may have been the technical difficulties experienced using telepractice. There were some interruptions during Skype testing and during treatment related to internet connection issues. These interruptions may have had an effect on the research participants' performance and on the ability of the research assistants to accurately score the recorded samples.

Conclusion

The results of this study suggest that intensive stuttering therapy conducted using telepractice that focuses on implementing what is known about principles of motor relearning and neuroplasticity can be beneficial for individuals who stutter. Individuals with strong emotional responses to their stuttering and avoidance behaviors may benefit more from a program that also implements treatment that targets emotional reactions specifically. Stuttering therapy needs to be highly individualized to each client's needs and a program such as the one conducted in this study may be more successful when incorporated into a broader treatment plan. The use of telepractice can help to make treatment more available to clients with difficult schedules or who live in areas without stuttering specialists nearby. Continued research investigating motor relearning and neuroplasticity in relation to speech needs to be conducted in order to guide clinical practice that incorporates principles based on speech-specific evidence.

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Appendix A: Testing Protocol

Date:_____

Participant: _____ (A or B)

Research clinician: _____

Self-rated Speech Satisfaction:

Say to the participant: "How satisfied are you with your current level of fluency on a nine-point scale? 1 being extremely satisfied and 9 being extremely dissatisfied."

Show them the visual scale for speech satisfaction.

Record their response here:___

Monologue: 2-min

Say to the participant: "I will provide you with a choice of topics and I want you to produce a monologue for me for 2 minutes. Please be sure to continue talking even if it is no longer about the chosen topic. Continue speaking until I indicate to you that 2 minutes have passed. When 2 minutes have passed, I will inform you by raising my hand, at which point you may stop talking. Your choices of monologue topics are as follows: talk about what you did over the weekend or plan to do the following weekend, talk about what is happening at school or at work, or talk about what is happening with your friends or family. Please choose one and begin when you are ready."

Indicate that a 2-minute monologue was completed and recorded with no interruptions: _____

Conversation: 5-min

Choose 3 conversation topics from the posted list.

Say to the participant: "We will now have a 5-minute conversation. I will provide you with a choice of topics. After a topic has been chosen, it is expected that you actively participate in the conversation until the 5 minutes have passed. When 5 minutes have passed, I will indicate it to you by raising my hand and you may stop participating at that time. Your choices of conversation topics are as follows ___, ___, ___. Please choose one and initiate conversation when you are ready."

During the conversation, be sure to either a) interrupt, b) disagree, or c) ask for clarification 3 times. Please make the conversation as natural as possible and use any of the previous 3 conversation disruptors (or any combination of them) 3 times.

Interrupted: __
Disagreed: __
Asked for clarification: __

Indicate that a 5-minute conversation was completed and recorded with no interruptions: _____

Self-rated anxiety:

Say to the participant: "On a scale from 0-100, rate how anxious you felt about speaking during the conversation you just participated in. 0 represents no anxiety at all, and 100 represents the worst anxiety you can imagine."

Record their response here: ___

Self-rated Stuttering Severity:

Say to the participant: "Please make a judgment about the severity of your stuttering during the conversation you just participated in. Base this judgment on the following scale: 1 = NO STUTTERING and 9 = EXTREMELY SEVERE STUTTERING. What would you rate your stuttering severity?"

Show them the visual scale for stuttering severity.

Record response here: ___

Appendix B: Topics List

Conversation Topics
Gun control
TSA body scanning
Green revolution
Political affiliation
Government Shutdown
Death penalty
Legal drinking age
Human cloning
Music education being removed from public schools
Mac vs. PC
Android vs. Iphone
Raising the driving age
Obamacare
Human vs. Zombies
Violent video games
America should not give foreign aid
Performance enhancing drugs in sports
School age kids playing contact sports
Border fence for Mexico
Smoking in public spaces
GMO debate
Marijuana law
Obama's use of drones
Identity theft

Appendix C: Sample Home Practice Sheets

Week 5: Home Practice Activities 1/14-1/17

Tuesday (1/14/2014): **Completed**

Individual:

- Practice functional phrases with easy speech: 3x ____
- Practice reading out loud with easy speech: 5 min ____

Social:

- Use easy speech in all low-challenge conversations ____
- Use easy speech for first 2-3 sentences of moderate-challenge conversation: 3x ____
- Self-generated home activity:

Wednesday (1/15/2014):

Individual:

- Practice functional phrases with easy speech: 3x ____
- Practice reading out loud with easy speech: 5 min ____

Social:

- Use easy speech in all low-challenge conversations ____
- Use easy speech for first 2-3 sentences of moderate-challenge conversation: 3x ____
- Self-generated home activity:

Thursday (1/16/2014):

Individual:

- Practice functional phrases with easy speech: 3x ____
- Practice reading out loud with easy speech: 5 min ____

Social:

- Use easy speech in all low-challenge conversations ____
- Use easy speech for 3 minute moderate-challenge conversation: 3x ____
- Self-generated home activity:

Friday (1/17/2014):

Individual

- Practice functional phrases with easy speech: 3x ____
- Practice reading out loud with easy speech: 5 min ____

Social:

- Use easy speech in all low-challenge conversations ____
- Use easy speech for 3 minute moderate-challenge conversation: 3x ____

- Self-generated home activity:

Weekend:

Individual:

- Practice all functional phrases aloud using easy speech (3x) ____
- Read aloud using easy speech for (3 min) ____

Social:

- Self-recording of conversation in high-challenge situation (5 min; 2x) ____
- Use easy speech in all low-challenge conversations ____
- Use easy speech for first 2-3 sentences of high-challenge conversation: 1x ____
- Self-generated home activity:

Week 3: Home Practice Activities 12/3-12/6

Tuesday (11/26/2013): **Completed**

Individual:

- Practice functional phrases with easy speech: 3x ____
- Practice reading out loud with easy speech: 5 min ____

Social:

- Use easy speech in 3 minute low-challenge conversation: 3x ____
- Self-generated home activity:

Wednesday (11/27/2013):

Individual:

- Practice functional phrases with easy speech: 3x ____
- Practice reading out loud with easy speech: 5 min ____

Social:

- Use easy speech in 3 minute low-challenge conversation: 3x ____
- Self-generated home activity:

Thursday (11/28/2013):

Individual:

- Practice functional phrases with easy speech: 3x ____
- Practice reading out loud with easy speech: 5 min ____

Social:

- Use easy speech in 3 minute low-challenge conversation: 3x ____
- Self-generated home activity:

Friday (11/29/2013):

Individual

- Practice functional phrases with easy speech: 3x ____
- Practice reading out loud with easy speech: 5 min ____

Social:

- Use easy speech in 3 minute low-challenge conversation: 3x ____
- Use easy speech in 3 minute moderate-challenge conversation: 1x ____
- Self-generated home activity:

Weekend:

Individual:

- Practice all functional phrases aloud using easy speech (3x) ____
- Read aloud using easy speech for (3 min) ____

Social:

- Self-recording of conversation in high-challenge situation (5 min; 2x) ____
- Use easy speech in 3 minute low-challenge conversation: 3x ____
- Self-generated home activity:

Appendix D: Sample Lesson Plans

Week 6: Treatment Plan **1/21-1/24**

Tuesday (1/21/2014):

- Discussion: questions, difficulties, successes, emotional (5 min)
- Functional phrases (4 min)
- Reading (5 min)
- Phone (2.5 min)
- Rest (1 min)
- Conversation (5 min)
- Reading (5 min)
- Rest (1 min)
- Phone (2.5 min)
- Conversation (5 min)
- Functional phrases (4 min)

Wednesday (1/22/2014)

- Discussion: questions, difficulties, successes, emotional (5 min)
- Phone (2.5 min)
- Reading (5 min)
- Conversation (5 min)
- Rest (1 min)
- Functional phrases (4 min)
- Reading (5 min)
- Functional phrases (4 min)
- Rest (1 min)
- Phone (2.5 min)
- Conversation (5 min)

Thursday (1/23/2014)

- Discussion: questions, difficulties, successes, emotional (5 min)
- Conversation (5 min)
- Rest (1 min)
- Reading (5 min)
- Phone (2.5 min)
- Functional phrases (4 min)
- Rest (1 min)
- Conversation (5 min)
- Reading (5 min)
- Phone (2.5 min)
- Functional phrases (4 min)

Friday (1/24/2014)

- Discussion: questions, difficulties, successes, emotional (5 min)

- Reading (5 min)
- Conversation (5 min)
- Rest (1 min)
- Phone (2.5 min)
- Functional phrases (4 min)
- Reading (5 min)
- Phone (2.5 min)
- Functional phrases (4 min)
- Rest (1 min)
- Conversation (5 min)

Week 3: Treatment Plan **12/3-12/6**

Tuesday (12/3/2013):

- Discussion: questions, difficulties, successes, emotional (5 min)
- Functional phrases (5 min)
- Reading (5 min)
- Rest (1 min)
- Simple conversation (5 min)
- Reading (5 min)
- Rest (1 min)
- Simple conversation (5 min)
- Functional phrases (5 min)
- Reading (5 min)
- Simple conversation (5 min)

Wednesday (12/4/2013)

- Discussion: questions, difficulties, successes, emotional (5 min)
- Reading (5 min)
- Simple conversation (5 min)
- Rest (1 min)
- Functional phrases (4 min)
- Reading (5 min)
- Functional phrases (4 min)
- Rest (1 min)
- Simple conversation (5 min)
- Reading (5 min)
- Simple conversation (5 min)

Thursday (12/5/2013)

- Discussion: questions, difficulties, successes, emotional (5 min)
- Simple conversation (5 min)
- Rest (1 min)
- Reading (4 min)
- Functional phrases (5 min)
- Simple conversation (5 min)
- Reading (4 min)
- Rest (1 min)
- Functional phrases (5 min)
- Simple conversation
- Reading (4 min)

Friday (12/6/2013)

- Discussion: questions, difficulties, successes, emotional (5 min)
- Functional phrases (4 min)
- Reading (5 min)

- Rest (1 min)
- Conversation (5 min)
- Reading (5 min)
- Rest (1 min)
- Conversation (5 min)
- Functional phrases (4 min)
- Reading (5 min)
- Conversation (5 min)

Appendix E: Instructions For Self-Recording Device

Record yourself speaking twice for 5 minutes in high-challenge speaking situations after each 20 minute Skype testing session. Make sure that you make your recordings before the following Skype session.

Once we finish the first week of baseline testing, you will need to make your recordings sometime between Friday after your last session of the week and Tuesday before your first session of the following week.

Directions:

- Flip the switch to "on" and wait for the indicator light to switch from red to blue. The device will not be recording when the light is red so be sure that the light has switched to blue before you begin speaking.
- Try to keep the device as stationary as possible. The best way to ensure a clear recording is to set the device on a flat surface next to you while you are speaking. The device does not need to be at mouth level like a microphone. You can also hold the recording device while you are talking. Make sure that you keep your hand steady and your fingers in place while holding the device because too much movement will cause unwanted noise in the recording. Feel free to test the device yourself so that you are confident you can make a clear recording.
- When you are finished recording flip the switch to off.
- Plug the device into a USB port on your computer.
- A prompt should pop up that allows you to select the option "Open folder to view files." If a prompt does not appear, go to my computer and double-click "Removable Disk."
- Double-click on the folder named "RECORD"
- You should see recordings labeled "REC001.WAV" and "REC002.WAV" or something similar. The recordings are numbered in the order that you made them.
- Right click the files and select "rename."
- Change the name of the recording so they include your first initial and then the date the recording was taken (ex: "D11.12.2013").
- Double-click the file and listen to verify that you renamed the correct file.
- Right click on the file and select "copy."
- Right click on your desktop or in a file on your computer of your choosing and select "paste." This way you will have a backup of each file in case something happens to your recording device before bringing it to your Tuesday session.
- The recording devices do not appear to be especially durable so try to keep them in a safe place. If your device is not working, let me know as soon as possible and I will provide you with a new one.

If you have any questions feel free to email, text, or call me at any time.

Appendix F: Communication Partner Consent Form

I agree to allow graduate students and professors in the speech-language pathology program at WWU to have face-to-face conversations with me over Skype. None of my personal information will be shared with the communication partners unless I reveal that information myself during the conversation. The communication partners will not discuss their participation with anyone except for Daniel Shubert and Dr. Mathers-Schmidt. I understand that this agreement is not a requirement to continue my participation in this study.

_____ _____

Signature Date

Appendix G: Informed Consent Form

INFORMED CONSENT

Intensive Stuttering Therapy Based on Neuroplasticity: Treatment Efficacy for Adults Who Stutter

We are conducting a study to look at the effects of an intensive stuttering therapy program on the speech of adults who stutter. Our research will allow us to determine if an intensive therapy program is an effective alternative to the more typical one to two day a week therapy model.

The experimental procedures consist of one week of baseline testing, four weeks of treatment, four weeks without treatment, and another four weeks of treatment followed by final testing. Testing will be conducted throughout the experiment (including the four weeks without treatment) on a regular basis. This testing will include filling out questionnaires about the effect your speech has on you and your life, self-rating your anxiety, self-rating your speech satisfaction, self-rating your stuttering severity, recording your own speech in high-challenge situations, producing 3-minute monologues over skype, and participating in 5-minute, high-challenge conversations over skype. Treatment will consist of 50 minute sessions four times a week that include education and practice in the use of stuttering therapy techniques to improve fluency. Home practice activities will be assigned daily and self-recordings of your own speech will be required. You will not be charged for the treatment or testing being conducted.

Some psychological discomfort may be experienced while discussing the emotional impact of stuttering or while self-rating your own anxiety, speech satisfaction, and severity. High-challenge conversations that are required for the testing and home practice activities may also lead to slight psychological discomfort or stress.

This research should benefit you by providing you with strategies to help increase the fluency of your speech. Possible benefits may include: increased speech fluency and naturalness, reduced anxiety while speaking, increased speech satisfaction, increased awareness and reduction of secondary stuttering symptoms, and a better understanding of stuttering,

Dr. Mathers-Schmidt and Daniel Shubert will answer any questions that you might have at any point. Prior to the study, Daniel Shubert will conduct a briefing session to describe the process and to outline a schedule for tests and training sessions. Dr. Mathers-Schmidt will serve as the contact person regarding inquiries you might have about your rights. You should also report any research-related injury to Dr. Mathers-Schmidt. She can be reached at (360) 650-3172 or at Barbara.Mathers-Schmidt@wwu.edu. **Participation in this study is voluntary. At any time during the study you are free to withdraw your consent and to discontinue participation without penalty or loss of benefits to which you are otherwise entitled.** All records of your performance will be confidential. Each participant will be assigned a number upon entering the

study. Only that number will be used to identify each participant on data forms throughout the study.

If you have any questions about your participation or your rights as a research participant, you can contact the WWU Research Compliance Officer, Janai Symons, by phone at (360) 650-3082 or by email at janai.symons@wwu.edu. If during or after participation in this study you suffer from any adverse effects as a result of participation, please notify the research clinician directing the study or the WWU Research Compliance Officer.

Please indicate below if you agree to participate in this research. A copy of the completed form will be provided.

.....

I am at least 18 years of age and I agree to participate in the project being conducted by Dr. Barbara Mathers-Schmidt and Daniel Shubert (graduate student).

_____

Participant Signature

_____

Date

Appendix H: Initial Treatment Calendar

Week 1	Treatment Activities	Feedback	Individual home practice	Social communication home practice
TEST	● Collect 2 recorded speech samples (% SS and naturalness) ● 3 minute monologue (% SS and naturalness) ● 5 minute conversation (% SS and naturalness)	● Self-rated anxiety ● Self-rated speech satisfaction ● Self-rated stuttering severity		
Day 1	In clinic session: ● Create list of 10 functional phrases (10 min) ● Explain and discuss components of easy speech (10 min) ● Practice easy speech reading short phrases aloud (5 min) ● Rest (3 min) ● Practice easy speech using 10 functional phrases (10 min) ● Practice easy speech with spontaneous phrases (7 min)	KP & KR, high frequency, immediate	Practice functional phrases with easy speech: 3x	Greet spouse or friend with easy speech
Day 2	● Identify and discuss easy speech components most beneficial to each client (10 min) ● Functional phrases (5 min) ● Rest (2.5 min) ● Spontaneous phrases (5 min) ● Reading sentences (5 min) ● Spontaneous phrases (5 min) ● Rest (2.5 min)	KP & KR, high frequency, immediate	Practice functional phrases with easy speech: 3x	Use easy speech for functional phrases in real low-challenge contexts

	● Functional phrases (5 min) ● Reading sentences (5 min)			
Day 3	● Discussion: questions, difficulties, successes, emotional (10 min) ● Reading paragraphs (5 min) ● Monologues (5 min) ● Rest (2.5 min) ● Functional phrases (5 min) ● Monologues (5 min) ● Rest (2.5 min) ● Reading paragraphs (5 min) ● Functional phrases (5 min)	KP & KR, high frequency, immediate	Practice functional phrases with easy speech: 3x Practice reading out loud with easy speech: 3 min	Use easy speech for functional phrases in real low-challenge contexts
Day 4	● Discussion: questions, difficulties, successes, emotional (10 min) ● Functional phrases (5 min) ● Reading (5 min) ● Rest (2.5 min) ● Conversation w/ clinician (5 min) ● Reading (5 min) ● Rest (2.5 min) ● Conversation w/ clinician (5 min) ● Functional phrases (5 min)	KR, moderate frequency, delayed Focus on the naturalness, the ease, and the effective communication	Practice functional phrases with easy speech: 3x Practice reading out loud with easy speech: 3 min	Use easy speech for functional phrases in real low-challenge contexts
Weekend			Practice functional phrases with easy speech: 3x per day Practice reading out loud with easy speech: 3 min per day	Self-recording of conversation in high-challenge situation: 5 min 2x

Week 2	Treatment Activities	Feedback	Individual home practice	Social communication home practice
TEST	● Collect 2 recorded speech samples (% SS and naturalness) ● 3 minute monologue (% SS and naturalness) ● 5 minute conversation (% SS and naturalness)	● Self-rated anxiety ● Self-rated speech satisfaction ● Self-rated stuttering severity		
Day 5	In clinic session ● Discussion: questions, difficulties, successes, emotional 5 min) ● Reading (5 min) ● Conversation w/ clinician (5 min) ● Rest (2.5 min) ● Phone (2.5 min) ● Functional phrases (5 min) ● Reading (5 min) ● Functional phrases (5 min) ● Rest (2.5 min) ● Phone (2.5 min) ● Conversation w/ other (5 min)	KR, low frequency, delayed	Practice functional phrases with easy speech: 3x Practice reading out loud with easy speech: 5 min	Use easy speech in low-challenge 3 minute conversation: 3x
Day 6	● Discussion: questions, difficulties, successes, emotional (5 min) ● Phone (2.5) ● Conversation w/ clinician (5 min) ● Rest (2.5 min) ● Reading (5 min) ● Functional phrases (5 min) ● Rest (2.5 min) ● Conversation w/ other (5 min) ● Reading (5 min) ● Phone (2.5 min) ● Functional phrases (5 min)	KR, low frequency, delayed	Practice functional phrases with easy speech: 3x Practice reading out loud with easy speech: 5 min	Use easy speech in low-challenge 3 minute conversation: 5x

Day 7	• Discussion: questions, difficulties, successes, emotional (5 min) • Functional phrases (5 min) • Reading (5 min) • Phone (2.5 min) • Rest (2.5 min) • Conversation w/ other (5 min) • Phone (2.5 min) • Reading (5 min) • Rest (2.5 min) • Conversation w/ clinician (5 min) • Functional phrases (5 min)	KR, low frequency, delayed	Practice functional phrases with easy speech: 3x Practice reading out loud with easy speech: 5 min	Use easy speech in all low-challenge conversations
Day 8	• Discussion: questions, difficulties, successes, emotional (5 min) • Reading (5 min) • Conversation w/ clinician (5 min) • Rest (2.5 min) • Phone (2.5 min) • Functional phrases (5 min) • Reading (5 min) • Phone (2.5 min) • Functional phrases (5 min) • Rest (2.5 min) • Conversation w/ other (5 min)	KR, low frequency, delayed	Practice functional phrases with easy speech: 3x Practice reading out loud with easy speech: 5 min	Use easy speech in all low-challenge conversations Use easy speech in 3 minute high-challenge conversation: 1x
Weekend			Practice functional phrases with easy speech: 3x per day Practice reading out loud with easy speech: 5 min per day	Self-recording of conversation in high-challenge situation: 5 min 2x

Week 3	Treatment Activities	Feedback	Individual home practice	Social communication home practice
TEST	● Collect 2 recorded speech samples (% SS and naturalness) ● 3 minute monologue (% SS and naturalness) ● 5 minute conversation (% SS and naturalness)	● Self-rated anxiety ● Self-rated speech satisfaction ● Self-rated stuttering severity	● Partial Oases	
Day 9	In clinic session: ● Discussion: questions, difficulties, successes, emotional (5 min) ● Phone (2.5 min) ● Functional phrases (5 min) ● Reading (5 min) ● Rest (2.5 min) ● Conversation w/ other (5 min) ● Reading (5 min) ● Rest (2.5 min) ● Conversation w/ clinician (5 min) ● Functional phrases (5 min) ● Phone (2.5 min)	KR, low frequency, delayed	Practice functional phrases with easy speech: 3x Practice reading out loud with easy speech: 5 min	Use easy speech in all low-challenge conversations Use easy speech in 3 minute high-challenge conversation: 2x
Day 10	● Discussion: questions, difficulties, successes, emotional (5 min) ● Reading (5 min) ● Conversation w/ other (5 min) ● Rest (2.5 min) ● Phone (2.5 min) ● Functional phrases (5 min) ● Phone (2.5 min) ● Reading (5 min) ● Functional phrases (5 min) ● Rest (2.5 min) ● Conversation w/ clinician (5 min)	KR, low frequency, delayed	Practice functional phrases with easy speech: 3x Practice reading out loud with easy speech: 5 min	Use easy speech in all low-challenge conversations Use easy speech in 3 minute high-challenge conversation: 2x
Day	● Discussion: questions,	KR, low frequency,	Practice functional	Use easy speech in all

11	difficulties, successes, emotional (5 min) ● Conversation w/ other (5 min) ● Rest (2.5 min) ● Phone (2.5 min) ● Reading (5 min) ● Functional phrases (5 min) ● Phone (2.5 min) ● Rest (2.5 min) ● Conversation w/ clinician (5 min) ● Reading (5 min) ● Functional phrases (5 min)	delayed	phrases with easy speech: 3x Practice reading out loud with easy speech: 5 min	low-challenge conversations Use easy speech in 3 minute high-challenge conversation: 2x
Day 12	● Discussion: questions, difficulties, successes, emotional (5 min) ● Functional phrases (5 min) ● Phone (2.5 min) ● Reading (5 min) ● Rest (2.5 min) ● Conversation w/ other (5 min) ● Reading (5 min) ● Phone (2.5 min) ● Rest (2.5 min) ● Conversation w/ clinician (5 min) ● Functional phrases (5 min)	KR, low frequency, delayed	Practice functional phrases with easy speech: 3x Practice reading out loud with easy speech: 5 min	Use easy speech in all low-challenge conversations Use easy speech in 3 minute high-challenge conversation: 2x
Week end			Practice functional phrases with easy speech: 3x per day Practice reading out loud with easy speech: 5 min per day	Self-recording of conversation in high-challenge situation: 5 min 2x

Week 4	Treatment Activities	Feedback	Individual home practice	Social communication home practice
TEST	● Collect 2 recorded speech samples (% SS and naturalness) ● 3 minute monologue (% SS and naturalness) ● 5 minute conversation (% SS and naturalness)	● Self-rated anxiety ● Self-rated speech satisfaction ● Self-rated stuttering severity		
Day 13	In clinic session: ● Discussion: questions, difficulties, successes, emotional (5 min) ● Phone (2.5 min) ● Reading (5 min) ● Conversation w/ clinician (5 min) ● Rest (2.5 min) ● Functional phrases (5 min) ● Reading (5 min) ● Functional phrases (5 min) ● Rest (2.5 min) ● Phone (2.5 min) ● Conversation w/ other (5 min)	KR, low frequency, delayed	Practice functional phrases with easy speech: 3x Practice reading out loud with easy speech: 5 min	Use easy speech in all low-challenge conversations Use easy speech in all high-challenge conversations
Day 14	● Discussion: questions, difficulties, successes, emotional (5 min) ● Conversation w/ clinician (5 min) ● Rest (2.5 min) ● Reading (5 min) ● Phone (2.5 min) ● Functional phrases (5 min) ● Rest (2.5 min) ● Conversation w/ other (5 min) ● Reading (5 min) ● Phone (2.5 min) ● Functional phrases (5 min)	KR, low frequency, delayed	Practice functional phrases with easy speech: 3x Practice reading out loud with easy speech: 5 min	Use easy speech in all low-challenge conversations Use easy speech in all high-challenge conversations
Day	● Discussion: questions,	KR, low	Practice functional	Use easy speech in all

15	difficulties, successes, emotional (5 min) ● Functional phrases (5 min) ● Reading (5 min) ● Phone (2.5 min) ● Rest (2.5 min) ● Conversation w/ other (5 min) ● Reading (5 min) ● Rest (2.5 min) ● Phone (2.5 min) ● Conversation w/ clinician (5 min) ● Functional phrases (5 min)	frequency, delayed	phrases with easy speech: 3x Practice reading out loud with easy speech: 5 min	low-challenge conversations Use easy speech in all high-challenge conversations
Day 16	● Discussion: questions, difficulties, successes, emotional (5 min) ● Reading (5 min) ● Conversation w/ other (5 min) ● Rest (2.5 min) ● Phone (2.5 min) ● Functional phrases (5 min) ● Reading (5 min) ● Phone (2.5 min) ● Functional phrases (5 min) ● Rest (2.5 min) ● Conversation w/ clinician (5 min)	KR, low frequency, delayed	Practice functional phrases with easy speech: 3x Practice reading out loud with easy speech: 5 min	Use easy speech in all low-challenge conversations Use easy speech in all high-challenge conversations
Week end			Practice functional phrases with easy speech: 3x per day Practice reading out loud with easy speech: 5 min per day	Self-recording of conversation in high-challenge situation: 5 min 2x

No Treatment	Treatment Activities	Feedback	Individual home practice	Social communication home practice
TEST	• Collect 2 recorded speech samples (% SS and naturalness) • 3 minute monologue (% SS and naturalness) • 5 minute conversation (% SS and naturalness)	• Self-rated anxiety • Self-rated speech satisfaction • Self-rated stuttering severity	• Partial Oases	